JAPANESE [JP,10-135715,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] The 1st signal-transmission track which consists of a superconducting material, and the 2nd signal-transmission track which consists of a usual state conduction ingredient, The outgoing end of said 1st signal-transmission track is connected to the 1st digital disposal circuit which consists of superconducting materials. The outgoing end of said 2nd signal-transmission track is connected to the 2nd digital disposal circuit which consists of usual state conduction ingredients. And both the input edge of said 1st signal-transmission track and the input edge of said 2nd signal-transmission track are connected to the signal input transmission line, and it is one (here) twice (4+m [1/]/2) the die length of the guide wave length from the input edge of said 2nd signal-transmission track. m is a superconduction signal processor characterized by being the configuration which made short circuit connection of between the outward trip of the signal of said 2nd signal-transmission track, and return circuits in the location of zero or a positive integer through the property component from which an impedance changes depending on the temperature of said 2nd digital disposal circuit.
[Claim 2] The short circuit component which a property component turns into from the ingredient into which resistance changes suddenly with temperature, or in the configuration cooled by the same cooling member which consists of a capacitor by which the series connection was carried out to said short circuit component, and cools the 1st digital disposal circuit In the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit The superconduction signal processor according to claim 1 characterized by carrying out usual state conduction transition, and resistance going up, and making it said property component also serve as a value with the sufficiently bigger impedance of a property component than the characteristic impedance of the 2nd signal-transmission track.
[Claim 3] The superconduction signal processor according to claim 2 characterized by the ingredient into which resistance changes suddenly with temperature being a superconducting material.
[Claim 4] A property component consists of a diode switch, or the capacitor and diode switch by which the series connection was carried out. The variable resistive element from which resistance changes depending on the inductor for a signal cut and the temperature of the 1st digital disposal circuit is minded. In the configuration by which forward-bias connection of said diode switch was made in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit Resistance of said variable resistive element goes up, and the transition drive of said diode switch is carried out from an ON state at an OFF state. The superconduction signal processor according to claim 1 characterized by making it the impedance of a property component serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track.
[Claim 5] The superconduction signal processor according to claim 4 characterized by being the configuration cooled by the same cooling member which cools the 1st digital disposal circuit by a variable resistive element consisting of a superconducting material.
[Claim 6] A property component consists of a diode switch, or the capacitor and diode switch by

which the series connection was carried out. In the configuration which said diode switch drives through the inductor for a signal cut with the output from the temperature sensor which measures the temperature of the 1st digital disposal circuit By detecting the temperature rise of said 1st digital disposal circuit, and changing said diode switch into a forward-bias condition The superconduction signal processor according to claim 1 characterized by making it the impedance of a property component serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track.

[Claim 7] The 1st signal-transmission track and the 2nd signal-transmission track which consists of a usual state conduction ingredient, The outgoing end of said 1st signal-transmission track is connected to the 1st digital disposal circuit which consists of superconducting materials. The outgoing end of said 2nd signal-transmission track is connected to the 2nd digital disposal circuit which consists of usual state conduction ingredients. And both the input edge of said 1st signal-transmission track and the input edge of said 2nd signal-transmission track are connected to the signal input transmission line. Each input edge of said 1st signal-transmission track and said 2nd signal-transmission track to the guide wave length (here) twice (4+m [1/]/2) the die length of each m minds the 1st property component from which an impedance changes depending on the temperature of said 1st digital disposal circuit, and the 2nd property component in the location of zero or a positive integer. The superconduction signal processor characterized by being the configuration which made short circuit connection of between the outward trip of the signal of each transmission line, and return circuits respectively.

[Claim 8] The 1st property component The 1st diode switch, Or it consists of the 1st capacitor and 1st diode switch by which the series connection was carried out. Said 1st diode switch and 1st inductor for a signal cut are connected to a serial. The 1st variable resistive element from which resistance changes to juxtaposition depending on the temperature of the 1st digital disposal circuit is connected with this. In the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit in the configuration to which direct-current bias of these was carried out through bias resistance By resistance of said 1st variable resistive element going up, and changing said 1st diode switch into a forward-bias condition The superconduction signal processor according to claim 7 characterized by making the impedance of the 1st property component sufficiently smaller than the characteristic impedance of the 1st signal-transmission track.

[Claim 9] The superconduction signal processor according to claim 8 characterized by being the configuration cooled by the same cooling member which cools the 1st digital disposal circuit by the 1st variable resistive element consisting of a superconducting material.

[Claim 10] The 1st property component consists of a diode switch, or the 1st capacitor and 1st diode switch by which the series connection was carried out. [1st] In the configuration which said 1st diode switch drives through the 1st inductor for a signal cut with the output from the temperature sensor which measures the temperature of a digital disposal circuit 1 By detecting the temperature rise of said 1st digital disposal circuit, and changing said 1st diode switch into a forward-bias condition The superconduction signal processor according to claim 7 characterized by making the impedance of the 1st property component sufficiently smaller than the characteristic impedance of the 1st signal-transmission track.

[Claim 11] The short circuit component which the 2nd property component turns into from a superconducting material, Or it consists of the 2nd capacitor by which the series connection was carried out to the short circuit component which consists of a superconducting material. In the configuration cooled by the same cooling member which cools the 1st digital disposal circuit In the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit The superconduction signal processor according to claim 7 to 10 characterized by carrying out usual state conduction transition, and resistance going up, and making it said 2nd property component also serve as a value with the sufficiently bigger impedance of the 2nd property component than the characteristic impedance of the 2nd signal-transmission track.

[Claim 12] The 2nd property component The 2nd diode switch, Or consist of the 2nd capacitor and 2nd diode switch by which the series connection was carried out, and the 2nd variable

resistive element from which resistance changes depending on the 2nd inductor for a signal cut and the temperature of the 1st digital disposal circuit is minded. In the configuration by which forward-bias connection of said 2nd diode switch was made In the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit Resistance of said 2nd variable resistive element goes up, and the transition drive of said 2nd diode switch is carried out from an ON state at an OFF state. The superconduction signal processor according to claim 7 to 10 characterized by making it the impedance of the 2nd property component serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track.

[Claim 13] The 2nd property component The 2nd diode switch, Or it consists of the 2nd capacitor and 2nd diode switch by which the series connection was carried out. In the configuration which said 2nd diode switch drives through the 2nd inductor for a signal cut with the output from the temperature sensor which measures the temperature of the 1st digital disposal circuit By detecting the temperature rise of said 1st digital disposal circuit, and changing said 2nd diode switch into a forward-bias condition The superconduction signal processor according to claim 7 to 10 characterized by making it the impedance of the 2nd property component serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track.

[Claim 14] A superconduction signal processor given in claims 1-13 characterized by the 1st digital disposal circuit and the 2nd digital disposal circuit containing a filter element.

[Claim 15] The superconduction signal processor according to claim 1 to 14 characterized by a superconducting material consisting of an oxide superconductor.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the superconduction signal-processing unit incorporating the bypass processing circuit for preventing the signal-processing stall by usual state conduction transition of the superconducting material accompanying the temperature rise of a digital-disposal-circuit unit in digital-disposal-circuit units, such as a filter which used the superconducting material. Especially this invention is invention suitable for the digital disposal circuit for reception.
[0002]
[Description of the Prior Art] In the conventional superconduction signal-processing unit, two digital disposal circuits of the digital disposal circuit constituted with a digital disposal circuit and usual state conduction ingredients, such as a filter which used the superconducting material, are installed, and it had become the configuration which carries out the connection change of them with a bypass relay switch on an input-line way. Carrying out the monitor of the temperature of the superconduction digital-disposal-circuit section, the input-line way was connected to the superconduction digital disposal circuit, at the time of the temperature rise, the bypass relay switch was driven, the input-line way was changed to the bypass circuit of a usual state conduction ingredient, and, always, input signal processing was performed. For example, the superconduction signal-processing unit by the bypass relay switch of the through change to the digital disposal circuit in which the low noise amplifier (LNA) connected to the catalog of Superconducting Core Technologies and REACHTM of an Inc. company at a superconduction receiving filter and it was formed, and the coaxial track of the bypass sake at the time of a temperature rise is illustrated.
[0003]
[Problem(s) to be Solved by the Invention] In this superconduction signal-processing unit, since the superconducting material is used as a member of a digital disposal circuit, it is necessary to cool it and to use it by the superconduction transition state, but even when a superconduction digital disposal circuit stops operating in connection with the temperature rise of the superconducting material of a digital disposal circuit, it is required that stable signal-processing actuation of an input signal should be continuously performed by low loss and high sensitivity.
[0004] This invention performs signal-processing actuation of low loss and high sensitivity at the above times of superconduction actuation, and aims at implementation of stable signal-processing actuation continuously also at the time of the depression of the superconduction digital disposal circuit accompanying a temperature rise. In the Prior art, since about 1dB of signal propagation losses in the bypass relay switch of the change section of a superconduction digital disposal circuit and its bypass circuit etc. occurred, the technical problem at the sacrifice of the property of the superconduction digital disposal circuit 4 that a super-low loss property is the description occurred. When a digital disposal circuit 4 was a superconduction band pass filter and the bypass relay switch of 1dB of insertion losses was specifically used since an about 0.5dB insertion loss was realizable if it designs well, the engine performance was not for the insertion loss of the whole containing a superconduction digital disposal circuit to deteriorate

greatly with 1.5dB, and to be utilized.
[0005]
[Means for Solving the Problem] In order to solve this technical problem, invention according to claim 1 The 1st signal-transmission track which consists of a superconducting material, and the 2nd signal-transmission track which consists of a usual state conduction ingredient, The outgoing end of said 1st signal-transmission track is connected to the 1st digital disposal circuit which consists of superconducting materials. The outgoing end of said 2nd signal-transmission track is connected to the 2nd digital disposal circuit which consists of usual state conduction ingredients. And both the input edge of said 1st signal-transmission track and the input edge of said 2nd signal-transmission track are connected to the signal input transmission line, and it is one (here) twice (4+m [1/]/2) the die length of the guide wave length from the input edge of said 2nd signal-transmission track. m considers between the outward trip of the signal of said 2nd signal-transmission track, and return circuits as the configuration which made ****** connection in the location of zero or a positive integer through the property component from which an impedance changes depending on the temperature of said 2nd digital disposal circuit.
[0006] Moreover, the short circuit component which invention according to claim 2 becomes from the ingredient into which resistance changes [a property component according to claim 1] suddenly with temperature, or in the configuration cooled by the same cooling member which consists of capacitors by which the series connection was carried out to this short circuit component, and cools the 1st digital disposal circuit Said property component also carries out usual state conduction transition, resistance goes up, and it is made for the impedance of a property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit.
[0007] A superconducting material is desirable as an ingredient into which resistance changes suddenly with temperature especially. A property component according to claim 1 invention according to claim 4 Furthermore, a diode switch, Or consist of the capacitor and diode switch by which the series connection was carried out, and the variable resistive element from which resistance changes depending on the inductor for a signal cut and the temperature of the 1st digital disposal circuit is minded. Said diode switch considers as the configuration by which forward-bias connection was made, and in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit Resistance of said variable resistive element goes up, and the transition drive of said diode switch is carried out from an ON state at an OFF state, and it is made for the impedance of a property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track.
[0008] It is desirable to consider as the configuration cooled by the same cooling member which cools the 1st digital disposal circuit by a variable resistive element consisting of a superconducting material in said invention especially.
[0009] The property component 2 according to claim 1 invention according to claim 6 Moreover, a diode switch, Or it consists of the capacitor and diode switch by which the series connection was carried out. It considers as the configuration which said diode switch drives through the inductor for a signal cut with the output from the temperature sensor which measures the temperature of the 1st digital disposal circuit. It is made for the impedance of a property component to serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track by detecting the temperature rise of said 1st digital disposal circuit, and changing said diode switch into a forward-bias condition.
[0010] Next, the 2nd signal-transmission track where invention according to claim 7 consists of the 1st signal-transmission track and usual state conduction ingredient, The outgoing end of said 1st signal-transmission track is connected to the 1st digital disposal circuit which consists of superconducting materials. The outgoing end of said 2nd signal-transmission track is connected to the 2nd digital disposal circuit which consists of usual state conduction ingredients. And both the input edge of said 1st signal-transmission track and the input edge of said 2nd signal-transmission track are connected to the signal input transmission line. Each input edge of said

1st signal-transmission track and said 2nd signal-transmission track to the guide wave length (here) twice (4+m [1/]/2) the die length of each m makes short circuit connection of between the outward trip of the signal of each transmission line, and return circuits respectively in the location of zero or a positive integer through the 1st property component from which an impedance changes depending on the temperature of said 1st digital disposal circuit, and the 2nd property component.
[0011] Invention according to claim 8 the 1st property component according to claim 7 Furthermore, the 1st diode switch, Or it constitutes from the 1st capacitor and 1st diode switch by which the series connection was carried out. Said 1st diode switch and 1st inductor for a signal cut connect with a serial. The 1st variable resistive element from which resistance changes to juxtaposition depending on the temperature of the 1st digital disposal circuit is connected with this. Consider as the configuration to which direct-current bias of these was carried out through bias resistance, and in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit It is made to make the impedance of the 1st property component sufficiently smaller than the characteristic impedance of the 1st signal-transmission track by resistance of said 1st variable resistive element going up, and changing said 1st diode switch into a forward-bias condition.
[0012] In said invention, the configuration cooled by the same cooling member which cools the 1st digital disposal circuit by the 1st variable resistive element consisting of a superconducting material is desirable.
[0013] Invention according to claim 10 moreover, the 1st property component according to claim 7 It consists of a diode switch, or the 1st capacitor and 1st diode switch by which the series connection was carried out. [1st] It considers as the configuration which said 1st diode switch drives through the 1st inductor for a signal cut with the output from the temperature sensor which measures the temperature of a digital disposal circuit 1. It is made to make the impedance of the 1st property component sufficiently smaller than the characteristic impedance of the 1st signal-transmission track by detecting the temperature rise of said 1st digital disposal circuit, and changing said 1st diode switch into a forward-bias condition.
[0014] Furthermore, the short circuit component to which, as for invention according to claim 11, the 2nd property component of a publication becomes claims 7-10 from a superconducting material, Or it consists of the 2nd capacitor by which the series connection was carried out to the short circuit component which consists of a superconducting material. It considers as the configuration cooled by the same cooling member which cools the 1st digital disposal circuit. Said 2nd property component also carries out usual state conduction transition, resistance goes up, and it is made for the impedance of the 2nd property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit.
[0015] The track where the property component 2 consists of a superconducting material, Or it consists of a capacitor 2 by which the series connection was carried out to the track which consists of a superconducting material. It considers as the configuration cooled by the same cooling member which cools a digital disposal circuit 1. Said property component 2 also carries out usual state conduction transition, resistance goes up, and it is made for the impedance of the property component 2 to serve as a sufficiently big value from the characteristic impedance of the signal-transmission track 2 in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said digital disposal circuit 1.
[0016] The 2nd property component of a publication invention according to claim 12 to claims 7-10 Moreover, the 2nd diode switch, Or consist of the 2nd capacitor and 2nd diode switch by which the series connection was carried out, and the 2nd variable resistive element from which resistance changes depending on the 2nd inductor for a signal cut and the temperature of the 1st digital disposal circuit is minded. Said 2nd diode switch considers as the configuration by which forward-bias connection was made. In the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit Resistance of said 2nd variable resistive element goes up, and the transition drive of said 2nd

diode switch is carried out from an ON state at an OFF state, and it is made for the impedance of the 2nd property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track.

[0017] The 2nd property component of a publication invention according to claim 13 to claims 7-10 Moreover, the 2nd diode switch, Or it consists of the 2nd capacitor and 2nd diode switch by which the series connection was carried out. It considers as the configuration which said 2nd diode switch drives through the 2nd inductor for a signal cut with the output from the temperature sensor which measures the temperature of the 1st digital disposal circuit. It is made for the impedance of the 2nd property component to serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track by detecting the temperature rise of said 1st digital disposal circuit, and changing said 2nd diode switch into a forward-bias condition.

[0018] It is desirable as operation aspect of the above superconduction signal-transmission unit of this invention that the 1st digital disposal circuit and the 2nd digital disposal circuit contain a filter element.

[0019] Moreover, in operation of the superconduction signal-transmission unit of this invention, it is that an oxide superconductor uses for a superconducting material as desirable operation aspect.

[0020]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using drawing.

[0021] (Gestalt 1 of operation) Drawing 1 shows the conceptual diagram showing the configuration of the superconduction signal-processing unit by the gestalt of 1 operation of this invention, and the 1st signal-transmission track 1 is connected to the input conduction track 3 in drawing 1 in the location of 2nd signal-transmission track 2a and node A-A'. In explanation of the gestalt of this operation, and the gestalt of future operations, the gestalt of the expedient top of explanation and the transmission line is performed as an parallel track. The die length of 2nd signal-transmission track 2a is twice (4+m [1/]/2) the die length (it is here and m is zero or a positive integer) of the guide wave length (lambdag2), and 2nd signal-transmission track 2b which has the same property as it is connected to the location of other end C-C'. The 1st digital disposal circuit 4 which consists of superconducting materials is connected to another edge of the 1st signal-transmission track 1, and the 2nd digital disposal circuit 5 which consists of usual state conduction ingredients is connected to another edge of 2nd signal-transmission track 2b. Digital disposal circuits 4 and 5 are the circuit units which realized functions, such as a band-pass filter which lets only a desired signal pass, and a correlator which takes correlation of a spread-spectrum signal, and make the characteristic impedance of the signal-transmission track 1 and 2b adjust those input impedances mostly to object signal frequency. Short circuit connection of each outward trip and return circuit of a both line way is made with the property component 7 in the location of 2nd signal-transmission track 2a and node C-C' of 2b. An impedance changes depending on the temperature of the 1st digital disposal circuit 4, and the property component 7 consists of a superconducting material or a diode switch. when the temperature of the 1st digital disposal circuit 4 rises and the property deteriorates At the time so that the bad influence which it has on the system by the property degradation may be prevented For example, when it goes up to temperature which the superconducting material which constitutes it transfers from superconduction to usual state conduction, and causes property degradation Compared with the characteristic impedance of 2nd signal-transmission track 2a and 2b, what was constituted so that the impedance of the property component 7 might change from a very small value to a big value is used. The gestalt of concrete operation of the property component 7 is mentioned later. Here, the principle of operation is explained below.

[0022] (at the time of normal actuation) In drawing 1 , when a digital disposal circuit 4 is in the temperature which maintains a superconductive state and is functioning normally, it attaches and explains. The characteristic impedance of the input transmission line 3 and the 1st signal-transmission track 1, signal-transmission track of ** 2nd 2a, and 2b is respectively set to Z0, Z1, and Z2, and a propagation constant is set to beta0, beta1, and beta2. As for each characteristic

impedances Z0, Z1, and Z2, specifically, it is desirable to make all equal. Moreover, as for the input impedance of digital disposal circuits 4 and 5, it is desirable to have consistency mostly in the characteristic impedance of the signal-transmission track 1 and 2b respectively to the signal frequency currently now taken into consideration. Moreover, the impedance of the property component 7 is set to Zs2. Since it is as small a value as loss of signal-transmission track 2a and 2b can be disregarded when actual, the impedance Zin2 of 2nd signal-transmission track 2a seen from the location of A-A' in this case is set to (several 1).
[0023]
[Equation 1]
$$Z_{in2} = (Z_2)^2 / Z_{ct},$$

[0024] Here, ZCt is [0025].
[Equation 2]
$$Z_{ct} = Z_2 \cdot Z_{s2} / (Z_2 + Z_{s2})$$

[0026] It becomes. The impedance ZAin at the time of seeing the point of A-A' from the input transmission line 3 is given by the degree type.
[0027]
[Equation 3]
$$Z_{Ain} = Z_1 \cdot Z_{in2} / (Z_1 + Z_{in2})$$

[0028] Now, it becomes as big a value as ZCt becomes almost equal to Zs2 and two can be disregarded compared with ZinZ2, when sufficiently small compared with Zs 2Z2. Therefore, ZAin becomes almost equal to Z1. An input signal 8 is spread from the input transmission line 3 only to the direction of the signal-transmission track 1 (signal 9), and a signal 11 stops spreading it in the direction of signal-transmission track 2a in this operating state. Therefore, a signal 3 spreads almost without a loss [****], and signal processing is inputted and carried out to the 1st digital disposal circuit 4 as a signal 10. This processed output signal can be used in a system. Since it is advantageous constitutionally to cool like the superconduction digital disposal circuit 4, and to use as for the signal-transmission track 1, the propagation loss is small enough, it can ignore, and the signal power transmissibility T1 to the input signal 8 of a signal 10 is given by (several 4).

[0029]
[Equation 4]
$$T_1 = (1 - |\Gamma|^2) \cdot Z_0 / (Z_0 + Z_{s2})$$

[0030] Here, gamma is given by the degree type.
[0031]
[Equation 5]
$$\Gamma = -Z_{s2} / (2 Z_0 + Z_{s2})$$

[0032] Moreover, the signal transfer loss L1 (dB: decibel) is expressed with (several 6).
[0033]
[Equation 6]
$$L_1 = -10 \, \mathrm{Log}\,(T_1) \qquad (単位はdB)$$

[0034] As a concrete value, if Z0=Z1=Z2=50ohm, the signal transfer loss L1 can realize the value of 0.5dB or less by about 6.7ohms or less, and Zs2 can realize the value of 0.1dB or less by about 1.2 ohms.
[0035] (at the time of bypass actuation) Next, it attaches and explains to actuation in case the superconducting material of a digital disposal circuit 4 does not function normally at the temperature which carries out usual state conduction transition. Since the superconducting material of a digital disposal circuit 4 serves as usual state conduction in this condition, since the output of a digital disposal circuit 4 becomes less normal, in a system, it cannot use that that input impedance is shifted from the characteristic impedance of the signal-transmission

track 1 in many cases. On the other hand, in the direction of a digital disposal circuit 5, since a normal signal-processing output is obtained by the reason explained below, in a system, the stability of a system improves by choosing the signal of this one. It is attached to this principle of operation, and explains below.

[0036] In drawing 1, when the input impedance Z4 of a digital disposal circuit 4 does not have consistency in the characteristic impedance Z1 of the signal-transmission track 1, die-length less-than-carload lot1 of the signal-transmission track 1 can be adjusted, and the impedance Zin1 seen from the A-A' point can be set up sufficiently more greatly than the characteristic impedance Z0 of the input transmission line 3. When Z4 is smaller than Z1, by making track die-length less-than-carload lot1 one (it being here and m being zero or a positive integer) twice (4+m [1/]/2) the die length of the guide wave length, impedance conversion is carried out like (a-one number), and, specifically, it can be made a sufficiently big impedance. Moreover, conversely, when Z4 is larger than Z1, one can be made equal at ZinZ4 by making track die-length less-than-carload lot1 one (here, k being zero or a positive integer) twice (k/2) the die length of the guide wave length. such a configuration -- setting -- an input signal 8 -- all are almost transmitted in the direction of signal-transmission track 2a (when the impedance of the property component 7 is sufficiently larger than Z2, it is, so that it may state below). Moreover, since Zin1 can be considered as the pure resistance R by adjusting less-than-carload lot1, it is attached to the value of R at this time, and the transfer loss over the input signal 8 of a signal 11 is set to about -0.1dB or less, when the value of R is Zabout 2 or more twice 1 and the value of about -0.18dB or less and R is about 2.8 or more times of Z1. Moreover, in node A-A', when Z4 has consistency in Z1, although some reflection exists, a signal 11 spreads to signal-transmission track 2a (in being Z1=Z2=Z0, one third of reflection will occur, and to signal-transmission track 2a, one third of the power of an input signal 8 will spread).

[0037] When the components of the 1st signal-transmission track 1 are usual state conduction metals, such as copper metallurgy, although it is as mentioned above since a characteristic impedance and transmission loss are hardly affected even if the temperature changes dozens degrees near 77K In using oxide high-temperature-supercondactor ingredients, such as oxide high temperatures supercondactor, such as Y system, and Bi system, Tl system Since the resistivity at the time of a usual state conduction condition is a fairly large value about 10-3ohmcm and compared with a metal, a greatly different phenomenon will appear in the time of a superconductive state, and the time of carrying out usual state conduction transition. It is concretely explained below by making the transmission line into stripline track structure.

[0038] Although the 1/4 guide wave length is set to about 13mm at this time that what is necessary is just to set track width of face to about 0.17mm in order to set that characteristic impedance to 50 ohms when LaAlO3 single crystal (specific inductive capacity 24) with a thickness of 0.5mm is used for a substrate Since the direct current resistance of the stripline track per cm is set to about 600ohms, the magnitude of attenuation of a signal serves as a value of about 38 dB/cm extent on a frequency of 1.5GHz which is used by mobile communications. Since a signal decreases almost also by the die length whose track length less-than-carload lot 1 is about 5mm, one becomes almost equal regardless of the input impedance of a digital disposal circuit 4 at ZinZ1. Therefore, in this case, the input impedance of the 1st signal-transmission track which the component of the 1st signal-transmission track 1 looked at from node A-A' in the time of a superconductive state and a usual state conduction condition serves as the almost same value, and since Z1 and Z2 are usually taken equally to Z0 in this case, to signal-transmission track 2a, one third of the power of an input signal 8 will spread it as mentioned above.

[0039] as mentioned above -- although it depends for the rate on a design -- an input signal 8 -- a little, or serves as a signal 11 and spreads the inside of 2nd signal-transmission track 2a. The signal transfer loss (ratio of the power of a signal 112 to the power of a signal 111) L2 in node B-B' by the impedance Zs2 of the property component 7 is expressed with (several 7).

[0040]

[Equation 7]

$$L_2 = \{1 - (\frac{Z_2}{2Z_{s2} + Z_2})^2\} \frac{Z_{s2}}{Z_{s2} + Z_2}$$

[0041] For example, the signal transfer loss L2 is set to about 0.4dB by the case where Zs2/Z2 are 10, and, as for the signal transfer loss L2, about 0.1dB or less is realized for Zs2/Z2 or more by 43. Thus, since there is almost no reflection by node C-C' and it will be inputted into a digital disposal circuit 5 as a signal 12 by making the impedance Zs2 of the property component 7 into a value bigger enough than the characteristic impedance Z2 of signal-transmission track 2a, in the whole system, desired signal processing becomes possible by using this output. Generally, since a digital disposal circuit 5 consists of usual state conduction ingredients, such as a metal, although it is inferior to the digital disposal circuit 4 which consists of superconducting materials in respect of loss and properties, such as sensibility, stable signal-processing-system actuation is realizable in this way with the configuration of this invention.
[0042] It is attached to invention about the property component 7 described here, and a drawing is used for below and an example is explained to it.
[0043] (Gestalt 2 of operation) Drawing 2 shows the conceptual diagram showing the first operation gestalt of the property component (2) part which is the component of the superconduction signal-processing unit by the gestalt of 1 operation of this invention. The example constituted from a capacitor 127 by which the series connection was carried out to the short circuit component 117 which the property component 107 as a means to change an impedance by drawing 2 in connection with the temperature of a digital disposal circuit 4 (it illustrates to drawing 1) in node C-C' with the 2nd signal-transmission track 102a and 102b turns into from the ingredient into which resistance changes suddenly with temperature is shown. What is necessary is to limit nothing to this, but for the superconducting material which constitutes a digital disposal circuit 4 to be the temperature below the temperature transferred to usual state conduction from superconduction, and just to be with the ingredient with which resistance decreases rapidly, although it is desirable to use a superconducting material as an ingredient into which resistance changes suddenly with temperature. For example, the CMR (giant magneto-resistance) ingredient of La1-xSrxMnO3 which shows an unusual temperature resistivity change, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade etc. can be used.
[0044] In drawing 2 , there is no capacitor 127 and short circuit connection of between direct continuation point C-C' may be made with the superconduction short circuit component 117. Both difference is that short circuit connection is made not only an alternating current target but in direct current by the latter to short circuit connection of the signal-transmission tracks 102a and 102b being made by the property component 107 only on an alternating current target in the former. Moreover, in drawing 2 , although illustration is not carried out, the superconduction short circuit component 117 needs to be constituted so that it may install and cool to the same cooling member as the cooling member which cools the 1st digital disposal circuit 4 (it illustrates to drawing 1). In case the superconducting material which constitutes it transfers to usual state conduction in connection with the temperature rise of the 1st digital disposal circuit 4, when the superconduction short circuit component 117 which constitutes the property component 107 also carries out usual state conduction transition and resistance goes up, an impedance is able to design from a very small value, at the time of a superconductive state, so that it may change to an extremely big value (refer to the inside of the explanatory note of the gestalt 1 of said operation). A configuration in which the impedance Zs2 of the property component 107 serves as a sufficiently bigger value than the characteristic impedance Z2 of 2nd signal-transmission track 2a (it illustrates to drawing 1) is realizable with this. Therefore, also when the 1st digital disposal circuit 4 stops functioning by the temperature rise as the gestalt 1 of operation explained, stable signal-processing-system actuation can be realized by changing and using for an output from the 2nd digital disposal circuit 5.
[0045] Specifically as an ingredient of the superconduction short circuit component 117 Whether it is the same as the superconducting material which constitutes a digital disposal circuit 4 Y systems, such as similar LnBa2Cu 3O7-x (Ln=Y and rare earth elements), and Bi system of

Bi2Sr2Can-1CunO2n+4-y (n=1-5), It is convenient to use oxide high temperatures supercondactor, such as Tl system oxide high temperatures supercondactor, such as Tl2Ba2Can-1CunO2n+4 (n=1-4), Tl1Ba2Can-1CunO2n+3 (n=1-5), and Tl1Sr2Can-1CunO2n+3 (2 n= 3). By the temperature rise by failure of a refrigerator etc., since both transition temperature becomes almost equal in using the same superconductor as the superconducting material which constitutes the 1st digital disposal circuit 4 especially, if the 1st digital disposal circuit 4 stops operating, mostly, it will become possible to change a signal-processing function automatically at the 2nd digital disposal circuit 5 (to refer to drawing 1), and the temperature monitor for it will become unnecessary at coincidence.

[0046] Moreover, what is necessary is for treating as a concentrated constant to be possible if the die length of the superconduction short circuit component 117 is about about 1 of the guide wave length / 10, and with it [more than], to treat as a distributed constant track and just to design to a desired impedance. For example, if 50-ohm track of a stripline mold is considered as signal conduction track 2a, using LaAlO3 single crystal (specific inductive capacity 24) with a thickness of 0.5mm as a substrate, since the 1/10 guide wave length will be set to about 5.2mm, if it designs below by this die length, treating as a concentrated constant is possible. For example, as shown in drawing 8 , if the superconduction short circuit component 717 is made into die length of 5mm, width of face of 23 micrometers, and the thickness of 1 micrometer, at the node of the signal-transmission tracks 702a and 702b of the outward trip of a stripline mold If it will be set to about 2150 ohms if the resistivity near transition temperature forms the oxide elevated-temperature superconducting thin film which is 10-3ohmcm, and the characteristic impedance of the 2nd signal-transmission track 702a and 702b sets to 50 ohms The signal transfer loss (ratio of the power of a signal 712 to the power of a signal 711) L2 is set to about 0.1dB from (several 7). Moreover, in the superconductive state, such a small impedance is realizable that it can completely ignore compared with 50 ohms. This superconduction short circuit component is connected to a terminal 737, and the terminal 737 is connected to the earth electrode 704 which is the return circuit of the signal-transmission tracks 702a and 702b in a beer hall 727. Moreover, although drawing 8 showed the example which made short circuit connection between the direct signal-transmission tracks 702a and 702b and an earth electrode 704, it cannot be overemphasized that a capacitor may be inserted in a serial in the meantime, and short circuit connection may be made.

[0047] In addition, although the ingredient of a short circuit component was described about the case where a superconductor is used, it cannot be overemphasized that the ingredient which is not necessarily limited to this at all and has the same function can be used. It cannot be overemphasized that an ingredient with which single or more figures resistivity becomes large may be used instead of a superconductor near the temperature which the superconducting material of the 1st digital disposal circuit 4 transfers to usual state conduction from superconduction. The CMR (giant magneto-resistance) ingredient of La1-xSrxMnO3 which specifically shows an unusual temperature resistivity change, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade etc. can be used.

[0048] (Gestalt 3 of operation) Drawing 3 is the conceptual diagram showing the second operation gestalt of a property component part of the superconduction signal-processing unit configuration element by the gestalt of 1 operation of this invention. The second operation gestalt of the property component part in this invention is explained using this drawing. The property component 207 as a means to change an impedance by drawing 3 in connection with the temperature of a digital disposal circuit 4 (it illustrates to drawing 1) in node C-C' with the 2nd signal-transmission track 202a and 202b consists of the capacitors 227 and diode switches 217 by which the series connection was carried out. A capacitor 227 is for omitting a direct current, and on circuitry, when it is not necessary to prepare independently, it may not be. It is constituted by the both ends of a diode switch 217 so that the series connection of the variable resistive element 247 from which resistance changes depending on the inductor 237 for a signal cut and the temperature of the 1st digital disposal circuit may be carried out and bias of the diode switch 217 may be carried out to the forward direction by the power source 267. Moreover, in this drawing, there is no capacitor 227 and a diode switch 217 may make direct

short circuit connection at node C-C'. Both difference is as the gestalt 2 of said operation having described. Moreover, in drawing 3 , although illustration is not carried out, as for a variable resistive element 247, it is desirable to be constituted so that it may install and cool to the same cooling member as the cooling member which cools the 1st digital disposal circuit 4 (it illustrates to drawing 1).
[0049] First, the case where the property component 207 is constituted within the dimension which can be treated as a lumped constant circuit is explained. When the temperature of the 1st digital disposal circuit 4 maintains superconduction operating state and normal function and actuation are being performed, resistance of a variable resistive element 247 is a very small value. When a variable resistive element 247 consists of superconducting materials especially, it is in a superconductive state in this case, and that resistance is zero. Therefore, although the electrical potential difference of a power source 267 passes along a variable resistive element 247 and an inductor 237 and is impressed to the diode switch 217 in the forward direction, since the direct current resistance of a variable resistive element 247 and an inductor 237 is very small, in this case, the bias current to a diode switch 217 will become large, and will be in switch-on. The impedance to the signals 211 and 212 of the diode switch 217 used as switch-on serves as a value smaller enough than the characteristic impedance Z2 of the signal-transmission tracks 202a and 202b. If the electrostatic capacity of a capacitor 227 is chosen as magnitude from which an impedance becomes a value small enough, the short circuit condition that the impedance of the property component 207 is also small enough is realizable.
[0050] Since the direct current resistance will become large and the bias current will become very small as for a diode switch 217 when a variable resistive element 247 transfers from a superconductive state to a usual state conduction condition if the superconducting material which constitutes it transfers to usual state conduction in connection with the temperature rise of the 1st digital disposal circuit 4, it transfers to a high resistance condition or a cut off state. In this condition, the impedance Zs2 to signals 211 and 212 serves as a value bigger enough than the characteristic impedance Z2 of the signal-transmission tracks 202a and 202b, and can realize the condition near a release condition. Therefore, also when the 1st digital disposal circuit 4 stops functioning by the temperature rise as the gestalt 1 of operation explained, stable signal-processing-system actuation can be realized by changing and using for an output from the 2nd digital disposal circuit 5.
[0051] Next, the case where it consists of dimensions with required treating the property component 207 as a distributed constant circuit is explained. Since the impedance of a diode switch 217 turns into an impedance of the property component 207 as it is by carrying out to one (here, k being zero or a positive integer) twice (k/2) the die length of the guide wave length by adjusting suitably the die length of the track which connects a diode switch 217 to the signal-transmission tracks 202a and 202b, the above actuation is realizable.
[0052] Or by carrying out parallel connection of the variable resistive element to the series circuit of an inductor 237 and a diode switch 217, as shown in drawing 6 As a configuration which makes a diode switch 217 a low impedance condition contrary to the above-mentioned case only when a variable resistive element carries out usual state conduction transition The die length of the track which connects a diode switch 217 to the signal-transmission tracks 202a and 202b by considering as the wavelength (4+m [1/]/2) (m being zero or a positive integer) of the guide wave length The same with being shown in (several 1), since impedance reversal starts, the condition that the impedance of the property component 2 transfers from a short circuit condition to a high impedance condition in case a variable resistive element carries out usual state conduction transition is realizable.
[0053] As a configuration of the concrete property component 207, as a diode switch 217, when using the oxide high temperature supercondactor which contains copper, such as oxide high temperatures supercondactor, such as Y system, and Bi system, Tl system, in the temperature to which the 1st digital disposal circuit 4 operates, for example, the superconductor which is the component, it is desirable to use schottky diodes, such as diode for RFs which operates also with liquid nitrogen temperature (77K) extent, for example, a GaAs system etc., etc. Moreover, it is desirable to use the oxide high temperature supercondactor containing copper, such as Y

system, Bi system, and Tl system, as an ingredient of a variable resistive element 247. By fixing to the same cooling member as it, in using the same object as the superconducting material which constitutes the 1st digital disposal circuit 4 especially, if the 1st digital disposal circuit 4 stops operating, mostly, it will become possible to change a signal-processing function automatically at the 2nd digital disposal circuit 5 (to refer to drawing 1), and a temperature monitor will become unnecessary by the temperature rise by failure of a refrigerator etc., at coincidence.

[0054] In addition, although the above-mentioned explanation described the ingredient of a variable resistive element 247 about the case where a superconductor is used, it cannot be overemphasized that the ingredient which is not necessarily limited to this at all and has the same function can be used. It cannot be overemphasized that an ingredient with which single or more figures resistivity becomes large may be used instead of a superconductor near the temperature which the superconducting material of the 1st digital disposal circuit 4 transfers to usual state conduction from superconduction. Specifically, the CMR (giant magneto-resistance) ingredient of La1-xSrxMnO3 which specifically shows an unusual temperature resistivity change, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade etc. can be used.

[0055] (Gestalt 4 of operation) Drawing 4 shows the conceptual diagram showing the third operation gestalt of a property component part of the superconduction signal-processing unit configuration element by the gestalt of 1 operation of this invention. In drawing 4 , the property component 307 as a means to change an impedance in connection with the temperature of the 1st digital disposal circuit 4 (it illustrates to drawing 1) consists of diode switches 317 in node C-C' with the 2nd signal-transmission track 302a and 302b. In the another embodiment, the capacitor for cutting a direct current into a diode switch 317 at a serial may be formed. In the both ends of a diode switch 317, the output line of the drive circuit 367 is connected to the serial through the inductor 337 for a signal cut. As an input signal of the drive circuit 367, the temperature sensor 357 which carries out the monitor of the temperature of the 1st digital disposal circuit 4 is connected. The output of the drive circuit 367 is controlled depending on the output of a temperature sensor 357 in which the 1st digital disposal circuit carries out a temperature monitor.

[0056] First, the case where it consists of dimensions with it as the property component 307 can deal with it as a lumped constant circuit is explained. [as small] A diode switch 317 is driven in the low impedance condition, and always operates the 1st digital disposal circuit 4. In order to prevent the depression of a system, when changing a digital disposal circuit, by the rise of the operating temperature of the 1st digital disposal circuit 4, the property component 307 can be transferred to a high impedance from a short circuit (low impedance) condition by making the drive current of the drive circuit 367 small by making a diode switch 317 into an OFF state (high impedance condition).

[0057] Next, in the case of the dimension which the property component 307 must deal with as a distributed constant circuit, the same function is realizable if it is made to be the same as that of what was stated with the above-mentioned (gestalt 3 of operation).

[0058] As mentioned above, as well as the aforementioned operation gestalt when the 1st digital disposal circuit 4 stops functioning by the temperature rise, the superconduction signal-processing unit which can realize stable signal-processing-system actuation can be realized by changing and using for an output from the 2nd digital disposal circuit 5.

[0059] In this example, since the impedance of a diode switch 317, i.e., the impedance of the property component 317, is controlled by the output of a temperature sensor 357 in the drive circuit 367, before being able to set the change temperature of normal actuation and bypass actuation as arbitration and the superconduction digital disposal circuit's 4 stopping operating, it is possible to change to the 2nd digital disposal circuit 5 of a bypass beforehand. By doing in this way, it becomes possible to raise the dependability of a superconduction signal-processing unit, and stability.

[0060] (Gestalt 5 of operation) Drawing 5 shows the conceptual diagram showing the superconduction signal-processing unit by the gestalt of other operations of this invention. In drawing 5 , 1st signal-transmission track 401a is connected to the input conduction track 403 in

the location of 2nd signal-transmission track 402a and node A-A'. In explanation of the gestalt of this operation, and the gestalt of future operations, the gestalt of the expedient top of explanation and the transmission line is performed as an parallel track.

[0061] The die length of 1st signal-transmission track 401a is twice (4+m [1/]/2) the die length (it is here and m is zero or a positive integer) of the guide wave length (lambdag1), and 1st signal-transmission track 401b which has the same property as it is connected to the location of other end B-B'. The 1st digital disposal circuit 404 which consists of superconducting materials is connected to another [the] edge. Short circuit connection of each outward trip and return circuit of a both line way is made with the property component 406 in the location of node B-B'. An impedance changes depending on the temperature of the 1st digital disposal circuit 404, and the property component 406 consists of a diode switch, a superconducting material, etc.

[0062] On the other hand, the die length of 2nd signal-transmission track 402a is twice (4+m [1/]/2) the die length (it is here and m is zero or a positive integer) of the guide wave length (lambdag2), and 2nd signal-transmission track 402b which has the same property as it is connected to the location of the other end C-C'. While will signal-transmission track 402b Accept the 2nd, and the 2nd digital disposal circuit 405 which consists of usual state conduction ingredients is connected to the edge. Short circuit connection of each outward trip and return circuit of a both line way is made with the property component 407 in the location of node C-C'. An impedance changes depending on the temperature of the 1st digital disposal circuit 404, and the property component 407 consists of a diode switch, a superconducting material, etc.

[0063] Digital disposal circuits 404 and 405 are the circuit units which realized functions, such as a band-pass filter which lets only a desired signal pass, and a correlator which takes correlation of a spread-spectrum signal, and it is desirable that those input impedances are mostly adjusted by each characteristic impedance of the signal-transmission tracks 401b and 402b to object signal frequency.

[0064] when the temperature of the 1st digital disposal circuit 404 rises and the property deteriorates At the time so that the bad influence which it has on the system by the property degradation may be prevented for example, when it goes up to temperature which the superconducting material which constitutes it transfers from superconduction to usual state conduction, and causes property degradation It compares with the characteristic impedance of the 1st signal-transmission track 401a and 401b. It is constituted so that it may change from a value with the very small impedance of the property component 406 to a big value. Compared with the characteristic impedance of the 2nd signal-transmission track 402a and 402b, what was constituted so that the impedance of the property component 407 might change from a very small value to a big value is used. The gestalt of concrete operation of the property components 406 and 407 is mentioned later.

[0065] In operation of this invention according to claim 7, with the normal operating temperature which has the 1st digital disposal circuit 404 in a superconductive state, one is the input impedance ZinZ1 (= Z0) of 1st signal-transmission track 401a seen from node A-A', and the input impedance Zin2 of 2nd signal-transmission track 402a is a high impedance. Conversely, Zin1 consists of temperature at the time of the bypass actuation which the 1st digital disposal circuit 404 transferred to the usual state conduction condition so that it may become a high impedance and two may become equal at ZinZ2 (= Z0). The detailed principle of operation is explained below.

[0066] (at the time of normal actuation) In drawing 5 , when a digital disposal circuit 404 is in the temperature which maintains a superconductive state and is functioning normally, it attaches and explains. The characteristic impedance of the input transmission line 403, the 1st signal-transmission track 401a and 401b, and the 2nd signal-transmission track 402a and 402b is respectively set to Z0, Z1, and Z2, and a propagation constant is set to beta0, beta1, and beta2. As for each characteristic impedances Z0, Z1, and Z2, specifically, it is desirable to make all equal. Moreover, as for the input impedance of digital disposal circuits 404 and 405, it is desirable to have consistency mostly respectively to the signal frequency currently now taken into consideration in the characteristic impedance of the signal-transmission tracks 401b and 402b. Moreover, the impedance of the property components 406 and 407 is respectively set to Zs1

and Zs2.
[0067] Rather than ZsZ1, one is fully large, and in the case of this operating state, since it was as small a value as two can ignore, as (the gestalt 1 of operation) described, the input impedance Zin2 of 2nd signal-transmission track 402a will be in a high impedance condition, and an input signal 408 does not almost have loss than ZsZ2, and it is inputted into it as a signal 409 at 1st signal-transmission track 401a. A signal 409 receives the reflection loss of very few signals by short circuit connection of the property component 406 in node B-B', and spreads it as an input signal 410 to a digital disposal circuit 404. In this case, it is (several 6), and Z2 can be transposed to Z1, it can transpose Zs2 to Zs1, and the loss received by node B-B' can be evaluated. If attached to actuation of 2nd signal-transmission track 402a, it is the same as that of (the gestalt 1 of operation).
[0068] As mentioned above, at the time of normal actuation, a processing output is obtained from the 1st digital disposal circuit 404, and **** and the signal transfer loss in the middle also become possible [making it very small].
[0069] (at the time of bypass actuation) Next, it attaches and explains to actuation, i.e., bypass actuation, in case the superconducting material of a digital disposal circuit 404 does not function normally at the temperature which carries out usual state conduction transition. Since the superconducting material of a digital disposal circuit 404 serves as usual state conduction in this condition, that output cannot be used in a system. On the other hand, in the direction of a digital disposal circuit 405, since a normal signal-processing output is obtained by the same reason as (the gestalt 1 of operation), in a system, the stability of a system improves by choosing the signal of this one.
[0070] In this condition the impedance Zs1 of the 1st property component 406 in node B-B' Since it is a very small value compared with Z1, the input impedance Zin1 of signal-transmission track 401a seen from node A-A' is set to (several 1) and (several 2). Z1 is asked for Zs2 by replacing Z2 with Zs1 for Zin2 to Zin1, and Zs1 can realize a very big value. Asking, when the impedance ZAin at the time of seeing the point of A-A' from the input transmission line 403 is (several 3), Z1 is transposed to Z2 and it transposes Zin2 to Zin1, ZAin becomes almost equal to Z2. An input signal 408 is spread from the input transmission line 403 only to the direction of signal-transmission track 402a (signal 411), and a signal 409 stops therefore, spreading it in the direction of signal-transmission track 401a.
[0071] Moreover, since the impedance of the property component 407 in node C-C' consists of this condition so that it may become a very high value compared with a characteristic impedance Z2, the signal signal 411 is spread without receiving only the very slight signal transfer loss by short circuit connection of the property component 407, and signal processing is inputted and carried out to the 2nd digital disposal circuit 405 as a signal 412. In a system, this processed output signal can be used and stable signal-processing-system actuation can be realized.
[0072] It is advantageous constitutionally to cool like the superconduction digital disposal circuit 404, and to use, and they are small enough, and since the signal-transmission tracks 401a, 401b, 402a, and 402b can be disregarded, they are desirable. [of the propagation loss of the track itself] It is desirable to use a usual state conduction metal which does not change the resistance not much a lot by the temperature change, for example, copper metallurgy etc., as a configuration electrode material of signal-transmission track 401a in the configuration of this invention. It is because a characteristic impedance and transmission loss are hardly affected even if, as for this, the temperature changes dozens degrees near 77K, so the above actuation can be realized easily.
[0073] As mentioned above, with this operation gestalt, the signal transfer loss at the time of an input signal 408 spreading as a signal 412 to the 2nd digital disposal circuit 405 at the time of bypass actuation has composition which can be done small easily from the case of (the gestalt 1 of operation). The still more detailed explanation about this invention is described below.
[0074] (Gestalt 6 of operation) Drawing 6 shows the conceptual diagram showing the first operation gestalt of the 1st property component part among the components in drawing 5 which shows other examples of an operation gestalt of the superconduction signal-processing unit of this invention. It sets to drawing 6 and is one (here) twice (4+m [1/]/2) the die length of the

guide wave length (lambdag1). m is set to node B-B' of 1st signal-transmission track 501a of zero or a positive integer, and signal-transmission track 501b. The 1st property component 506 as a means to change an impedance in connection with the temperature of a digital disposal circuit 404 (it illustrates to drawing 5) consists of the capacitor 527 and the 1st diode switch 517 by which the series connection was carried out. A capacitor 527 is for omitting a direct current, and on circuitry, when it is not necessary to prepare independently, it may not be. The series connection of the 1st inductor 537 for a signal cut is carried out, a diode switch 517, the 1st variable resistive element 547 from which resistance changes to the both ends of the series circuit of an inductor 537 depending on the temperature of the 1st digital disposal circuit 404, and a power source 567 and the series-connection circuit of bias resistance 557 are connected to juxtaposition, and when the resistance of a variable resistive element 547 is sufficiently large, it is constituted by **** of the 1st diode switch 517 so that the forward bias of the diode switch 517 may be carried out.

[0075] on the other hand, as a configuration of the 2nd property component 407 in drawing 5 for example, the thing using the superconduction short circuit component 117 as shown in drawing 2 -- or the thing using the series circuit of the 2nd diode switch as shown in drawing 3 , the 2nd inductor 237, and the 2nd variable resistive element 247 -- further In the 2nd inductor 337 of the 2nd diode switch 317 as shown in drawing 4 , and series connection, what considered operating temperature of the 1st digital disposal circuit 404 (drawing 5) as the configuration driven by the drive circuit 367 in the input from the temperature sensor 357 which carries out a monitor is used. It is as having described the above-mentioned (gestalten 3-5 of operation) about those functional actuation.

[0076] Moreover, in drawing 6 , although the 1st variable resistive element 547, the superconduction short circuit component 117, or the 2nd variable resistive element 247 grade is not illustrated, it is desirable to be constituted so that it may install and cool to the same cooling member as the cooling member which cools the 1st digital disposal circuit 404 (drawing 5).

[0077] When the 1st digital disposal circuit which consists of a superconducting material by considering as such a configuration is in a superconductive state, the impedance of the 1st property component 506 serves as a big value near a release condition, and the impedance of the 2nd property component 407 (drawing 5) can make it the very small value of a short circuit condition. Therefore, a functional operation which was explained in (the gestalt 5 of operation) is discovered, and also when the 1st digital disposal circuit 404 which consists of a superconducting material stops functioning by the temperature rise, stable signal-processing-system actuation can be realized by changing and using for an output from the 2nd digital disposal circuit 405.

[0078] Below, the concrete operation gestalt of the 1st property component 506 is explained. First, the case where the 1st property component 506 is constituted within the dimension which can be treated as a lumped constant circuit is explained. When the temperature of the 1st digital disposal circuit 404 (drawing 5) maintains superconduction operating state and normal function and actuation are being performed, resistance of the 1st variable resistive element 547 is a very small value. When a variable resistive element 547 consists of superconducting materials especially, it is in a superconductive state in this condition, and that resistance is zero. Therefore, since bias voltage is not impressed to the 1st diode switch 517 in order that the electrical potential difference of a power source 567 may connect too hastily by the variable resistive element 547, it is an OFF state (high impedance condition). The electrostatic-capacity value of a capacitor 527 is large enough, and since it sets up so that the impedance may become small enough and the impedance Zs1 of the property component 506 becomes almost equal to the impedance of the 1st diode switch 517, it becomes a very big value. Therefore, in node B-B', a signal 509 is spread without almost receiving loss, turns into a signal 510, and is supplied to the 1st superconduction digital disposal circuit 404.

[0079] If the superconducting material which constitutes it transfers to usual state conduction in connection with the temperature rise of the 1st digital disposal circuit 404, when the 1st variable resistive element 547 transfers from a superconductive state to a usual state conduction condition The direct current resistance becomes large. To the 1st diode switch 517 A forward

bias is carried out to the 1st inductor 537 by which the series connection was carried out by the power source 567 through bias resistance 557, a current flows, the impedance becomes a very small value and the impedance Zs1 of the property component 506 becomes very small. Since the die length is lambda (4+m [1/]/2)g1 (it is here and m is zero or a positive integer), like the above-mentioned principle, impedance conversion of Zs1 of a small value is carried out, and the input impedance of 1st signal-transmission track 501a in node A-A' turns into the very large impedance Zin1.

[0080] Next, the case where it consists of dimensions with required treating the property component 506 as a distributed constant circuit is explained. Since the impedance of the 1st diode switch 517 turns into the impedance Zs1 of the property component 506 as it is by making into the guide wave length (here, k being zero or a positive integer) twice (k/2) the die length of the guide wave length the die length of the track which connects the 1st diode switch 517 to the signal-transmission tracks 501a and 501b, the above actuation is realizable.

[0081] Or by carrying out parallel connection of the 1st variable resistive element to the series circuit of the 1st inductor and the 1st diode switch, as shown in drawing 3 As a configuration which makes the 1st diode switch a low impedance condition contrary to the above-mentioned case only when the 1st variable resistive element carries out usual state conduction transition The die length of the track which connects the 1st diode switch to the signal-transmission tracks 501a and 501b by considering as the wavelength (4+m [1/]/2) (m being zero or a positive integer) of the guide wave length (Several 1) The same with being shown in a formula, impedance reversal is carried out and the condition that the impedance Zs1 of the property component 506 transfers from a short circuit condition to a high impedance condition in case a variable resistive element carries out usual state conduction transition can be realized.

[0082] As mentioned above, the property component 506 can be constituted as a lumped constant circuit or a distributed constant circuit.

[0083] As above configurations of the 1st concrete property component 506 The temperature to which the 1st digital disposal circuit 404 which consists of superconducting materials operates as the 1st diode switch 517, for example, in using the oxide high temperature supercondactor which contains copper, such as oxide high temperatures supercondactor, such as Y system, and Bi system, Tl system, in the superconductor which is the component It is desirable to use schottky diodes, such as diode for RFs which operates also with liquid nitrogen temperature (77K) extent, for example, a GaAs system etc., etc. Moreover, it is desirable to use the oxide high temperature supercondactor containing copper, such as Y system, Bi system, and Tl system, as an ingredient of the 1st variable resistive element 547. By fixing to the same cooling member as it, in using the same object as the superconducting material which constitutes the 1st digital disposal circuit 404 especially, if the 1st digital disposal circuit 404 stops operating, mostly, it will become possible to change a signal-processing function automatically at the 2nd digital disposal circuit 405, and a temperature monitor will become unnecessary by the temperature rise by failure of a refrigerator etc., at coincidence.

[0084] In addition, although the above-mentioned explanation described the ingredient of the 1st variable resistive element 547 about the case where a superconductor is used, it cannot be overemphasized that the ingredient which is not necessarily limited to this at all and has the same function can be used. It cannot be overemphasized that an ingredient with which single or more figures resistivity becomes large may be used instead of a superconductor near the temperature which the superconducting material of the 1st digital disposal circuit 4 transfers to usual state conduction from superconduction. Specifically, the CMR (giant magneto-resistance) ingredient of La1-xSrxMnO3 which specifically shows an unusual temperature resistivity change, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade etc. can be used.

[0085] Moreover, it is as having described the concrete operation gestalt of the property component 407 (drawing 5) in (the gestalten 3-5 of operation).

[0086] (Gestalt 7 of operation) Drawing 7 shows the conceptual diagram showing the second operation gestalt of the 1st property component part among the components in drawing 5 which shows other examples of an operation gestalt of the superconduction signal-processing unit of this invention. It sets to drawing 7 and is one (here) twice (4+m [1/]/2) the die length of the

guide wave length (lambdag1). m is set to node C-C' of 1st signal-transmission track 601a of zero or a positive integer, and 1st signal-transmission track 601b. The property component 606 as a means to change an impedance in connection with the temperature of the 1st digital disposal circuit 404 (drawing 5) consists of the 1st diode switch 616 and its bias circuit, and a capacitor 626 for a direct-current cut connected to it at the serial. In the another embodiment, it may be circuitry which does not contain a capacitor 626. In the both ends of the 1st diode switch 516, the output line of the 1st drive circuit 666 is connected to the serial through the 1st inductor 636 for a signal cut. As an input signal of the 1st drive circuit 666, the 1st temperature sensor 656 which carries out the monitor of the temperature of the 1st digital disposal circuit 404 is connected. The output of the 1st drive circuit 666 is controlled depending on the output of the 1st temperature sensor 656.

[0087] Functional actuation of the 1st property component is explained below. First, the case where it consists of dimensions with it as the 1st property component 606 can deal with it as a lumped constant circuit is explained. [as small] The 1st diode switch 616 is always made into the OFF state (high impedance condition). The impedance Zs1 of the property component 606 at this time is a very big value, and it is possible to constitute so that the signal transfer loss in node B-B' may serve as a very small value.

[0088] In order to prevent the depression of the system by the rise of the operating temperature of the 1st digital disposal circuit 404, in changing a digital disposal circuit, it drives the 1st diode switch 616 to switch-on (or an ON state: low impedance condition) by enlarging the drive current of the 1st drive circuit 666. The impedance Zs1 of the property component 606 at this time becomes very small, and a signal 609 is reflected nearly completely by node B-B'. Therefore, the input impedance of 1st signal-transmission track 601a seen from node A-A' becomes very large as mentioned above compared with Z1. At this time, an input signal 408 (drawing 5) is spread to 2nd signal-transmission track 402a (drawing 5) (signal 411).

[0089] Next, in the case of the dimension which the 1st property component 606 must deal with as a distributed constant circuit, the same function is realizable with a configuration similar to the above-mentioned.

[0090] Moreover, about the concrete operation gestalt of the property component 407 (drawing 5), it is possible to use what was described in (the gestalten 3-5 of operation).

[0091] As mentioned above, as well as the aforementioned operation gestalt when the 1st digital disposal circuit 404 stops functioning by the temperature rise, the superconduction signal-processing unit which can realize stable signal-processing-system actuation can be realized by changing and using for an output from the 2nd digital disposal circuit 5.

[0092] In this example, since it is the 1st drive circuit 666 and the impedance Zs1 of the 1st diode switch 616, i.e., the impedance of the 1st property component 606, is controlled by the output of the 1st temperature sensor 656, before being able to set the change temperature of normal actuation and bypass actuation as arbitration and the superconduction digital disposal circuit's 404 stopping operating, it is possible to change to the 2nd digital disposal circuit 405 of a bypass circuit beforehand. By doing in this way, it becomes possible to raise the dependability of a superconduction signal-processing unit, and stability.

[0093] (Gestalt 8 of operation) Drawing 8 shows the structure illustration showing other operation gestalten of a property component part of the superconduction signal-processing unit configuration element by the gestalt of operation of this invention. In explanation of the gestalt of the above operation, for convenience, although the gestalt of the transmission line was performed as an parallel track, it is not the thing of explanation to limit to this track structure. It is also good to use a stripline mold track as shown in drawing 8 . In this case, although here explains the case where the superconduction short circuit component corresponding to drawing 2 is used, in the 2nd property component using drawing 8 since the device is required for the approach of constituting the 1st or the 2nd property component, it cannot be overemphasized the case where other configurations are used, and that it can apply similarly about the 1st property component.

[0094] In drawing 8 , the superconduction short circuit component 717 is connected at the node of the outward trips 702a and 702b of the signal of the 2nd signal-transmission track. This node

corresponds to C point in drawing 2 . The return circuit of the signal of the 2nd signal-transmission track is an earth electrode 704. The other end of the superconduction short circuit component 717 is connected to the terminal 737. The terminal 737 is electrically connected with the earth electrode 704 by the beer hall 727 established in the substrate. A node with the earth electrode 704 of a beer hall 727 corresponds to node C' in drawing 2 . Thus, even if it uses flat-surface circuitry, it is possible to constitute a superconduction digital-disposal-circuit unit which was described above.
[0095] in addition, the superconducting material which constitutes the 1st digital disposal circuit 4,404 from the above explanation -- or The superconducting material which constitutes a superconduction short circuit component, a variable resistive element, etc. Y systems, such as LnBa2Cu 3O7-x (Ln=Y and rare earth elements), and Bi system of Bi2Sr2Can-1CunO2n+4-y (n=1-5), Although the example constituted using oxide-high-temperatures-supercondactor, such as Tl system oxide high temperatures supercondactor, such as Tl2Ba2Can-1CunO2n+4 (n=1-4), Tl1Ba2Can-1CunO2n+3 (n=1-5), and Tl1Sr2Can-1CunO2n+3 (2 n= 3), explained It can carry out similarly about other Hg system oxide high temperatures supercondactor.
[0096] Moreover, although the example constituted using substrate LaAlO3 single crystal explained, it can carry out similarly about other MgO(s), or SrTiO3 and GaAlO3 grade.
[0097] Furthermore, although the example which constituted the ingredient of a short circuit component and a variable resistive element using the superconductor explained An ingredient with which single or more figures resistivity becomes small below at the temperature which other ingredients and the superconducting material of the 1st digital disposal circuit transfer to usual state conduction from superconduction, For example, it can carry out similarly about the CMR (giant magneto-resistance) ingredient of La1-xSrxMnO3, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade.
[0098]
[Effect of the Invention] the digital disposal circuit for a bypass which consists of usual state conduction ingredients also when the operating temperature of a superconduction signal-processing unit rises and a superconductive state breaks according to this invention as mentioned above -- low loss -- and since it becomes possible to change automatically and to perform signal processing, the very remarkable effectiveness that are high sensitivity and signal processing of high-reliability and the Takayasu quality becomes possible is acquired.

[Translation done.]

TECHNICAL FIELD

[Field of the Invention] This invention relates to the superconduction signal-processing unit incorporating the bypass processing circuit for preventing the signal-processing stall by usual state conduction transition of the superconducting material accompanying the temperature rise of a digital-disposal-circuit unit in digital-disposal-circuit units, such as a filter which used the superconducting material. Especially this invention is invention suitable for the digital disposal circuit for reception.
[0002]

[Translation done.]

* NOTICES *

PRIOR ART

[Description of the Prior Art] In the conventional superconduction signal-processing unit, two digital disposal circuits of the digital disposal circuit constituted with a digital disposal circuit and usual state conduction ingredients, such as a filter which used the superconducting material, are installed, and it had become the configuration which carries out the connection change of them with a bypass relay switch on an input-line way. Carrying out the monitor of the temperature of the superconduction digital-disposal-circuit section, the input-line way was connected to the superconduction digital disposal circuit, at the time of the temperature rise, the bypass relay switch was driven, the input-line way was changed to the bypass circuit of a usual state conduction ingredient, and, always, input signal processing was performed. For example, the superconduction signal-processing unit by the bypass relay switch of the through change to the digital disposal circuit in which the low noise amplifier (LNA) connected to the catalog of Superconducting Core Technologies and REACHTM of an Inc. company at a superconduction receiving filter and it was formed, and the coaxial track of the bypass sake at the time of a temperature rise is illustrated.

[Translation done.]

EFFECT OF THE INVENTION

(Giant magneto-resistance) An ingredient etc. can be used.

[0044] In drawing 2 , there is no capacitor 127 and short circuit connection of between direct continuation point C-C' may be made with the superconduction short circuit component 117. Both difference is that short circuit connection is made not only an alternating current target but in direct current by the latter to short circuit connection of the signal-transmission tracks 102a and 102b being made by the property component 107 only on an alternating current target in the former. Moreover, in drawing 2 , although illustration is not carried out, the superconduction short circuit component 117 needs to be constituted so that it may install and cool to the same cooling member as the cooling member which cools the 1st digital disposal circuit 4 (it illustrates to drawing 1). In case the superconducting material which constitutes it transfers to usual state conduction in connection with the temperature rise of the 1st digital disposal circuit 4, when the superconduction short circuit component 117 which constitutes the property component 107 also carries out usual state conduction transition and resistance goes up, an impedance is able to design from a very small value, at the time of a superconductive state, so that it may change to an extremely big value (refer to the inside of the explanatory note of the gestalt 1 of said operation). A configuration in which the impedance Zs2 of the property component 107 serves as a sufficiently bigger value than the characteristic impedance Z2 of 2nd signal-transmission track 2a (it illustrates to drawing 1) is realizable with this. Therefore, also when the 1st digital disposal circuit 4 stops functioning by the temperature rise as the gestalt 1 of operation explained, stable signal-processing-system actuation can be realized by changing and using for an output from the 2nd digital disposal circuit 5.

[0045] Specifically as an ingredient of the superconduction short circuit component 117 Whether it is the same as the superconducting material which constitutes a digital disposal circuit 4 Y systems, such as similar LnBa2Cu 3O7-x (Ln=Y and rare earth elements), and Bi system of Bi2Sr2Can-1CunO2n+4-y (n=1-5), It is convenient to use oxide high temperatures supercondactor, such as Tl system oxide high temperatures supercondactor, such as Tl2Ba2Can-1CunO2n+4 (n=1-4), Tl1Ba2Can-1CunO2n+3 (n=1-5), and Tl1Sr2Can-1CunO2n+3 (2 n= 3). By the temperature rise by failure of a refrigerator etc., since both transition temperature becomes almost equal in using the same superconductor as the superconducting material which constitutes the 1st digital disposal circuit 4 especially, if the 1st digital disposal circuit 4 stops operating, mostly, it will become possible to change a signal-processing function automatically at the 2nd digital disposal circuit 5 (to refer to drawing 1), and the temperature monitor for it will become unnecessary at coincidence.

[0046] Moreover, what is necessary is for treating as a concentrated constant to be possible if the die length of the superconduction short circuit component 117 is about about 1 of the guide wave length / 10, and with it [more than], to treat as a distributed constant track and just to design to a desired impedance. For example, if 50-ohm track of a stripline mold is considered as signal conduction track 2a, using LaAlO3 single crystal (specific inductive capacity 24) with a thickness of 0.5mm as a substrate, since the 1/10 guide wave length will be set to about 5.2mm, if it designs below by this die length, treating as a concentrated constant is possible. For example, as shown in drawing 8 , if the superconduction short circuit component 717 is made

into die length of 5mm, width of face of 23 micrometers, and the thickness of 1 micrometer, at the node of the signal-transmission tracks 702a and 702b of the outward trip of a stripline mold If it will be set to about 2150 ohms if the resistivity near transition temperature forms the oxide elevated-temperature superconducting thin film which is 10-3ohmcm, and the characteristic impedance of the 2nd signal-transmission track 702a and 702b sets to 50 ohms The signal transfer loss (ratio of the power of a signal 712 to the power of a signal 711) L2 is set to about 0.1dB from (several 7). Moreover, in the superconductive state, such a small impedance is realizable that it can completely ignore compared with 50 ohms. This superconduction short circuit component is connected to a terminal 737, and the terminal 737 is connected to the earth electrode 704 which is the return circuit of the signal-transmission tracks 702a and 702b in a beer hall 727. Moreover, although drawing 8 showed the example which made short circuit connection between the direct signal-transmission tracks 702a and 702b and an earth electrode 704, it cannot be overemphasized that a capacitor may be inserted in a serial in the meantime, and short circuit connection may be made.

[0047] In addition, although the ingredient of a short circuit component was described about the case where a superconductor is used, it cannot be overemphasized that the ingredient which is not necessarily limited to this at all and has the same function can be used. It cannot be overemphasized that an ingredient with which single or more figures resistivity becomes large may be used instead of a superconductor near the temperature which the superconducting material of the 1st digital disposal circuit 4 transfers to usual state conduction from superconduction. It is CMR of La1-xSrxMnO3 which specifically shows an unusual temperature resistivity change, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In this superconduction signal-processing unit, since the superconducting material is used as a member of a digital disposal circuit, it is necessary to cool it and to use it by the superconduction transition state, but even when a superconduction digital disposal circuit stops operating in connection with the temperature rise of the superconducting material of a digital disposal circuit, it is required that stable signal-processing actuation of an input signal should be continuously performed by low loss and high sensitivity.
[0004] This invention performs signal-processing actuation of low loss and high sensitivity at the above times of superconduction actuation, and aims at implementation of stable signal-processing actuation continuously also at the time of the depression of the superconduction digital disposal circuit accompanying a temperature rise. In the Prior art, since about 1dB of signal propagation losses in the bypass relay switch of the change section of a superconduction digital disposal circuit and its bypass circuit etc. occurred, the technical problem at the sacrifice of the property of the superconduction digital disposal circuit 4 that a super-low loss property is the description occurred. When a digital disposal circuit 4 was a superconduction band pass filter and the bypass relay switch of 1dB of insertion losses was specifically used since an about 0.5dB insertion loss was realizable if it designs well, the engine performance was not for the insertion loss of the whole containing a superconduction digital disposal circuit to deteriorate greatly with 1.5dB, and to be utilized.

[Translation done.]

MEANS

[Means for Solving the Problem] In order to solve this technical problem, invention according to claim 1 The 1st signal-transmission track which consists of a superconducting material, and the 2nd signal-transmission track which consists of a usual state conduction ingredient, The outgoing end of said 1st signal-transmission track is connected to the 1st digital disposal circuit which consists of superconducting materials. The outgoing end of said 2nd signal-transmission track is connected to the 2nd digital disposal circuit which consists of usual state conduction ingredients. And both the input edge of said 1st signal-transmission track and the input edge of said 2nd signal-transmission track are connected to the signal input transmission line, and it is one (here) twice (4+m [1/]/2) the die length of the guide wave length from the input edge of said 2nd signal-transmission track. m considers between the outward trip of the signal of said 2nd signal-transmission track, and return circuits as the configuration which made ****** connection in the location of zero or a positive integer through the property component from which an impedance changes depending on the temperature of said 2nd digital disposal circuit.
[0006] Moreover, the short circuit component which invention according to claim 2 becomes from the ingredient into which resistance changes [a property component according to claim 1] suddenly with temperature, or in the configuration cooled by the same cooling member which consists of capacitors by which the series connection was carried out to this short circuit component, and cools the 1st digital disposal circuit Said property component also carries out usual state conduction transition, resistance goes up, and it is made for the impedance of a property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit.
[0007] A superconducting material is desirable as an ingredient into which resistance changes suddenly with temperature especially. A property component according to claim 1 invention according to claim 4 Furthermore, a diode switch, Or consist of the capacitor and diode switch by which the series connection was carried out, and the variable resistive element from which resistance changes depending on the inductor for a signal cut and the temperature of the 1st digital disposal circuit is minded. Said diode switch considers as the configuration by which forward-bias connection was made, and in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit Resistance of said variable resistive element goes up, and the transition drive of said diode switch is carried out from an ON state at an OFF state, and it is made for the impedance of a property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track.
[0008] It is desirable to consider as the configuration cooled by the same cooling member which cools the 1st digital disposal circuit by a variable resistive element consisting of a superconducting material in said invention especially.
[0009] The property component 2 according to claim 1 invention according to claim 6 Moreover, a diode switch, Or it consists of the capacitor and diode switch by which the series connection was carried out. It considers as the configuration which said diode switch drives through the inductor for a signal cut with the output from the temperature sensor which measures the

temperature of the 1st digital disposal circuit. It is made for the impedance of a property component to serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track by detecting the temperature rise of said 1st digital disposal circuit, and changing said diode switch into a forward-bias condition.
[0010] Next, the 2nd signal-transmission track where invention according to claim 7 consists of the 1st signal-transmission track and usual state conduction ingredient, The outgoing end of said 1st signal-transmission track is connected to the 1st digital disposal circuit which consists of superconducting materials. The outgoing end of said 2nd signal-transmission track is connected to the 2nd digital disposal circuit which consists of usual state conduction ingredients. And both the input edge of said 1st signal-transmission track and the input edge of said 2nd signal-transmission track are connected to the signal input transmission line. Each input edge of said 1st signal-transmission track and said 2nd signal-transmission track to the guide wave length (here) twice (4+m [1/]/2) the die length of each m makes short circuit connection of between the outward trip of the signal of each transmission line, and return circuits respectively in the location of zero or a positive integer through the 1st property component from which an impedance changes depending on the temperature of said 1st digital disposal circuit, and the 2nd property component.
[0011] Invention according to claim 8 the 1st property component according to claim 7 Furthermore, the 1st diode switch, Or it constitutes from the 1st capacitor and 1st diode switch by which the series connection was carried out. Said 1st diode switch and 1st inductor for a signal cut connect with a serial. The 1st variable resistive element from which resistance changes to juxtaposition depending on the temperature of the 1st digital disposal circuit is connected with this. Consider as the configuration to which direct-current bias of these was carried out through bias resistance, and in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit It is made to make the impedance of the 1st property component sufficiently smaller than the characteristic impedance of the 1st signal-transmission track by resistance of said 1st variable resistive element going up, and changing said 1st diode switch into a forward-bias condition.
[0012] In said invention, the configuration cooled by the same cooling member which cools the 1st digital disposal circuit by the 1st variable resistive element consisting of a superconducting material is desirable.
[0013] Invention according to claim 10 moreover, the 1st property component according to claim 7 It consists of a diode switch, or the 1st capacitor and 1st diode switch by which the series connection was carried out. [1st] It considers as the configuration which said 1st diode switch drives through the 1st inductor for a signal cut with the output from the temperature sensor which measures the temperature of a digital disposal circuit 1. It is made to make the impedance of the 1st property component sufficiently smaller than the characteristic impedance of the 1st signal-transmission track by detecting the temperature rise of said 1st digital disposal circuit, and changing said 1st diode switch into a forward-bias condition.
[0014] Furthermore, the short circuit component to which, as for invention according to claim 11, the 2nd property component of a publication becomes claims 7-10 from a superconducting material, Or it consists of the 2nd capacitor by which the series connection was carried out to the short circuit component which consists of a superconducting material. It considers as the configuration cooled by the same cooling member which cools the 1st digital disposal circuit. Said 2nd property component also carries out usual state conduction transition, resistance goes up, and it is made for the impedance of the 2nd property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit.
[0015] The track where the property component 2 consists of a superconducting material, Or it consists of a capacitor 2 by which the series connection was carried out to the track which consists of a superconducting material. It considers as the configuration cooled by the same cooling member which cools a digital disposal circuit 1. Said property component 2 also carries out usual state conduction transition, resistance goes up, and it is made for the impedance of

the property component 2 to serve as a sufficiently big value from the characteristic impedance of the signal-transmission track 2 in the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said digital disposal circuit 1.
[0016] The 2nd property component of a publication invention according to claim 12 to claims 7-10 Moreover, the 2nd diode switch, Or consist of the 2nd capacitor and 2nd diode switch by which the series connection was carried out, and the 2nd variable resistive element from which resistance changes depending on the 2nd inductor for a signal cut and the temperature of the 1st digital disposal circuit is minded. Said 2nd diode switch considers as the configuration by which forward-bias connection was made. In the case of usual state conduction transition of the superconducting material accompanying the temperature rise of said 1st digital disposal circuit Resistance of said 2nd variable resistive element goes up, and the transition drive of said 2nd diode switch is carried out from an ON state at an OFF state, and it is made for the impedance of the 2nd property component to serve as a sufficiently big value from the characteristic impedance of the 2nd signal-transmission track.
[0017] The 2nd property component of a publication invention according to claim 13 to claims 7-10 Moreover, the 2nd diode switch, Or it consists of the 2nd capacitor and 2nd diode switch by which the series connection was carried out. It considers as the configuration which said 2nd diode switch drives through the 2nd inductor for a signal cut with the output from the temperature sensor which measures the temperature of the 1st digital disposal circuit. It is made for the impedance of the 2nd property component to serve as a sufficiently bigger value than the characteristic impedance of the 2nd signal-transmission track by detecting the temperature rise of said 1st digital disposal circuit, and changing said 2nd diode switch into a forward-bias condition.
[0018] It is desirable as operation aspect of the above superconduction signal-transmission unit of this invention that the 1st digital disposal circuit and the 2nd digital disposal circuit contain a filter element.
[0019] Moreover, in operation of the superconduction signal-transmission unit of this invention, it is that an oxide superconductor uses for a superconducting material as desirable operation aspect.
[0020]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained using drawing.
[0021] (Gestalt 1 of operation) Drawing 1 shows the conceptual diagram showing the configuration of the superconduction signal-processing unit by the gestalt of 1 operation of this invention, and the 1st signal-transmission track 1 is connected to the input conduction track 3 in drawing 1 in the location of 2nd signal-transmission track 2a and node A-A'. In explanation of the gestalt of this operation, and the gestalt of future operations, the gestalt of the expedient top of explanation and the transmission line is performed as an parallel track. The die length of 2nd signal-transmission track 2a is twice (4+m [1/]/2) the die length (it is here and m is zero or a positive integer) of the guide wave length (lambdag2), and 2nd signal-transmission track 2b which has the same property as it is connected to the location of other end C-C'. The 1st digital disposal circuit 4 which consists of superconducting materials is connected to another edge of the 1st signal-transmission track 1, and the 2nd digital disposal circuit 5 which consists of usual state conduction ingredients is connected to another edge of 2nd signal-transmission track 2b. Digital disposal circuits 4 and 5 are the circuit units which realized functions, such as a band-pass filter which lets only a desired signal pass, and a correlator which takes correlation of a spread-spectrum signal, and make the characteristic impedance of the signal-transmission track 1 and 2b adjust those input impedances mostly to object signal frequency. Short circuit connection of each outward trip and return circuit of a both line way is made with the property component 7 in the location of 2nd signal-transmission track 2a and node C-C' of 2b. An impedance changes depending on the temperature of the 1st digital disposal circuit 4, and the property component 7 consists of a superconducting material or a diode switch. when the temperature of the 1st digital disposal circuit 4 rises and the property deteriorates At the time so that the bad influence which it has on the system by the property degradation may be

prevented For example, when it goes up to temperature which the superconducting material which constitutes it transfers from superconduction to usual state conduction, and causes property degradation Compared with the characteristic impedance of 2nd signal-transmission track 2a and 2b, what was constituted so that the impedance of the property component 7 might change from a very small value to a big value is used. The gestalt of concrete operation of the property component 7 is mentioned later. Here, the principle of operation is explained below.
[0022] (at the time of normal actuation) In drawing 1 , when a digital disposal circuit 4 is in the temperature which maintains a superconductive state and is functioning normally, it attaches and explains. The characteristic impedance of the input transmission line 3 and the 1st signal-transmission track 1, signal-transmission track of ** 2nd 2a, and 2b is respectively set to Z0, Z1, and Z2, and a propagation constant is set to beta0, beta1, and beta2. As for each characteristic impedances Z0, Z1, and Z2, specifically, it is desirable to make all equal. Moreover, as for the input impedance of digital disposal circuits 4 and 5, it is desirable to have consistency mostly in the characteristic impedance of the signal-transmission track 1 and 2b respectively to the signal frequency currently now taken into consideration. Moreover, the impedance of the property component 7 is set to Zs2. Since it is as small a value as loss of signal-transmission track 2a and 2b can be disregarded when actual, the impedance Zin2 of 2nd signal-transmission track 2a seen from the location of A-A' in this case is set to (several 1).
[0023]
[Equation 1]
$$Z_{in2} = (Z_2)^2 / Z_{Ct},$$

[0024] Here, ZCt is [0025].
[Equation 2]
$$Z_{Ct} = Z_2 \cdot Z_{s2} / (Z_2 + Z_{s2})$$

[0026] It becomes. The impedance ZAin at the time of seeing the point of A-A' from the input transmission line 3 is given by the degree type.
[0027]
[Equation 3]
$$Z_{Ain} = Z_1 \cdot Z_{in2} / (Z_1 + Z_{in2})$$

[0028] Now, it becomes as big a value as ZCt becomes almost equal to Zs2 and two can be disregarded compared with ZinZ2, when sufficiently small compared with Zs 2Z2. Therefore, ZAin becomes almost equal to Z1. An input signal 8 is spread from the input transmission line 3 only to the direction of the signal-transmission track 1 (signal 9), and a signal 11 stops spreading it in the direction of signal-transmission track 2a in this operating state. Therefore, a signal 3 spreads almost without a loss [****], and signal processing is inputted and carried out to the 1st digital disposal circuit 4 as a signal 10. This processed output signal can be used in a system. Since it is advantageous constitutionally to cool like the superconduction digital disposal circuit 4, and to use as for the signal-transmission track 1, the propagation loss is small enough, it can ignore, and the signal power transmissibility T1 to the input signal 8 of a signal 10 is given by (several 4).

[0029]
[Equation 4]
$$T_1 = (1 - |\Gamma|^2) \cdot Z_0 / (Z_0 + Z_{s2})$$

[0030] Here, gamma is given by the degree type.
[0031]
[Equation 5]
$$\Gamma = -Z_{s2} / (2 Z_0 + Z_{s2})$$

[0032] Moreover, the signal transfer loss L1 (dB: decibel) is expressed with (several 6).
[0033]
[Equation 6]

$L_1 = -10 \, \mathrm{Log}(T_1)$ （単位はｄＢ）

[0034] As a concrete value, if Z0=Z1=Z2=50ohm, the signal transfer loss L1 can realize the value of 0.5dB or less by about 6.7ohms or less, and Zs2 can realize the value of 0.1dB or less by about 1.2 ohms.

[0035] (at the time of bypass actuation) Next, it attaches and explains to actuation in case the superconducting material of a digital disposal circuit 4 does not function normally at the temperature which carries out usual state conduction transition. Since the superconducting material of a digital disposal circuit 4 serves as usual state conduction in this condition, since the output of a digital disposal circuit 4 becomes less normal, in a system, it cannot use that that input impedance is shifted from the characteristic impedance of the signal-transmission track 1 in many cases. On the other hand, in the direction of a digital disposal circuit 5, since a normal signal-processing output is obtained by the reason explained below, in a system, the stability of a system improves by choosing the signal of this one. It is attached to this principle of operation, and explains below.

[0036] In drawing 1 , when the input impedance Z4 of a digital disposal circuit 4 does not have consistency in the characteristic impedance Z1 of the signal-transmission track 1, die-length less-than-carload lot1 of the signal-transmission track 1 can be adjusted, and the impedance Zin1 seen from the A-A' point can be set up sufficiently more greatly than the characteristic impedance Z0 of the input transmission line 3. When Z4 is smaller than Z1, by making track die-length less-than-carload lot1 one (it being here and m being zero or a positive integer) twice (4+m [1/]/2) the die length of the guide wave length, impedance conversion is carried out like (a-one number), and, specifically, it can be made a sufficiently big impedance. Moreover, conversely, when Z4 is larger than Z1, one can be made equal at ZinZ4 by making track die-length less-than-carload lot1 one (here, k being zero or a positive integer) twice (k/2) the die length of the guide wave length. such a configuration -- setting -- an input signal 8 -- all are almost transmitted in the direction of signal-transmission track 2a (when the impedance of the property component 7 is sufficiently larger than Z2, it is, so that it may state below). Moreover, since Zin1 can be considered as the pure resistance R by adjusting less-than-carload lot1, it is attached to the value of R at this time, and the transfer loss over the input signal 8 of a signal 11 is set to about -0.1dB or less, when the value of R is Zabout 2 or more twice 1 and the value of about -0.18dB or less and R is about 2.8 or more times of Z1. Moreover, in node A-A', when Z4 has consistency in Z1, although some reflection exists, a signal 11 spreads to signal-transmission track 2a (in being Z1=Z2=Z0, one third of reflection will occur, and to signal-transmission track 2a, one third of the power of an input signal 8 will spread).

[0037] When the components of the 1st signal-transmission track 1 are usual state conduction metals, such as copper metallurgy, although it is as mentioned above since a characteristic impedance and transmission loss are hardly affected even if the temperature changes dozens degrees near 77K In using oxide high-temperature-supercondactor ingredients, such as oxide high temperatures supercondactor, such as Y system, and Bi system, Tl system Since the resistivity at the time of a usual state conduction condition is a fairly large value about 10-3ohmcm and compared with a metal, a greatly different phenomenon will appear in the time of a superconductive state, and the time of carrying out usual state conduction transition. It is concretely explained below by making the transmission line into stripline track structure.

[0038] Although the 1/4 guide wave length is set to about 13mm at this time that what is necessary is just to set track width of face to about 0.17mm in order to set that characteristic impedance to 50 ohms when LaAlO3 single crystal (specific inductive capacity 24) with a thickness of 0.5mm is used for a substrate Since the direct current resistance of the stripline track per cm is set to about 600ohms, the magnitude of attenuation of a signal serves as a value of about 38 dB/cm extent on a frequency of 1.5GHz which is used by mobile communications. Since a signal decreases almost also by the die length whose track length less-than-carload lot 1 is about 5mm, one becomes almost equal regardless of the input impedance of a digital disposal circuit 4 at ZinZ1. Therefore, in this case, the input impedance of the 1st signal-transmission track which the component of the 1st signal-transmission track 1 looked at from

node A-A' in the time of a superconductive state and a usual state conduction condition serves as the almost same value, and since Z1 and Z2 are usually taken equally to Z0 in this case, to signal-transmission track 2a, one third of the power of an input signal 8 will spread it as mentioned above.
[0039] as mentioned above -- although it depends for the rate on a design -- an input signal 8 -- a little, or serves as a signal 11 and spreads the inside of 2nd signal-transmission track 2a. The signal transfer loss (ratio of the power of a signal 112 to the power of a signal 111) L2 in node B-B' by the impedance Zs2 of the property component 7 is expressed with (several 7).
[0040]
[Equation 7]

$$L_2 = \{1 - (\frac{Z_2}{2Z_{s2} + Z_2})^2\} \frac{Z_{s2}}{Z_{s2} + Z_2}$$

[0041] For example, the signal transfer loss L2 is set to about 0.4dB by the case where Zs2/Z2 are 10, and, as for the signal transfer loss L2, about 0.1dB or less is realized for Zs2/Z2 or more by 43. Thus, since there is almost no reflection by node C-C' and it will be inputted into a digital disposal circuit 5 as a signal 12 by making the impedance Zs2 of the property component 7 into a value bigger enough than the characteristic impedance Z2 of signal-transmission track 2a, in the whole system, desired signal processing becomes possible by using this output. Generally, since a digital disposal circuit 5 consists of usual state conduction ingredients, such as a metal, although it is inferior to the digital disposal circuit 4 which consists of superconducting materials in respect of loss and properties, such as sensibility, stable signal-processing-system actuation is realizable in this way with the configuration of this invention.
[0042] It is attached to invention about the property component 7 described here, and a drawing is used for below and an example is explained to it.
[0043] (Gestalt 2 of operation) Drawing 2 shows the conceptual diagram showing the first operation gestalt of the property component (2) part which is the component of the superconduction signal-processing unit by the gestalt of 1 operation of this invention. The example constituted from a capacitor 127 by which the series connection was carried out to the short circuit component 117 which the property component 107 as a means to change an impedance by drawing 2 in connection with the temperature of a digital disposal circuit 4 (it illustrates to drawing 1) in node C-C' with the 2nd signal-transmission track 102a and 102b turns into from the ingredient into which resistance changes suddenly with temperature is shown. What is necessary is to limit nothing to this, but for the superconducting material which constitutes a digital disposal circuit 4 to be the temperature below the temperature transferred to usual state conduction from superconduction, and just to be with the ingredient with which resistance decreases rapidly, although it is desirable to use a superconducting material as an ingredient into which resistance changes suddenly with temperature. For example, CMR of La1-xSrxMnO3 which shows an unusual temperature resistivity change, La1-xSr1+xMnO4, and a 1 (Nd, Sm) / 2Sr1 / 2MnO3 grade

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[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The conceptual diagram showing the superconduction signal-processing unit by the gestalt of 1 operation of this invention
[Drawing 2] The conceptual diagram showing the first operation gestalt of a property component part of the superconduction signal-processing unit configuration element by the gestalt of 1 operation of this invention
[Drawing 3] The conceptual diagram showing the second operation gestalt of a property component part of the superconduction signal-processing unit configuration element by the gestalt of 1 operation of this invention
[Drawing 4] The conceptual diagram showing the third operation gestalt of a property component part of the superconduction signal-processing unit configuration element by the gestalt of 1 operation of this invention
[Drawing 5] The conceptual diagram showing the superconduction signal-processing unit by the gestalt of other operations of this invention
[Drawing 6] The conceptual diagram showing the first operation gestalt of the 1st property component part of the component in other examples of an operation gestalt of the superconduction signal-processing unit of this invention (drawing 5)
[Drawing 7] The conceptual diagram showing the second operation gestalt of the 1st property component part of the component in other examples of an operation gestalt of the superconduction signal-processing unit of this invention (drawing 5)
[Drawing 8] The structure illustration showing other operation gestalten of the 2nd property component part of the superconduction signal-processing unit configuration element by the gestalt of operation of this invention
[Description of Notations]
1,401a, 401b, 501a, 501b, 601a, 601b 1st signal-transmission track
2a, 2b, 102a, 102b, 202a, 202b, 302a, 302b, 402a, 402b, 702a, 702b 2nd signal-transmission track
3 Input Transmission Line
4,404 The 1st digital disposal circuit
5,405 The 2nd digital disposal circuit
7, 107, 207, 307, 406, 407,506,606,707 Property component
8,408 Input signal
9, 10, 11, 12, 111, 112, 211, 212, 311, 312, 409, 410, 411, 412, 509, 510, 609,610,711,712 Signal
117,717 Short circuit component
127,227,527,626 Capacitor
217,317,517,616 Diode switch
237,337,537,636 Inductor
247,547 Variable resistive element
357,656 Temperature sensor
367,666 Drive circuit
704 Earth Electrode
727 Beer Hall

737 Terminal

[Translation done.]

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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号

特開平10－135715

(43)公開日　平成10年(1998) 5月22日

(51)Int.Cl.[6]	識別記号	F I	
H01P 5/12	ZAA	H01P 5/12	ZAAA
H01L 39/00	ZAA	H01L 39/00	ZAAZ
H01P 1/15	ZAA	H01P 1/15	ZAA
3/04	ZAA	3/04	ZAA

審査請求　未請求　請求項の数15　OL　(全 15 頁)

(21)出願番号　特願平8－291434

(22)出願日　平成8年(1996)11月1日

(71)出願人　000005821
松下電器産業株式会社
大阪府門真市大字門真1006番地

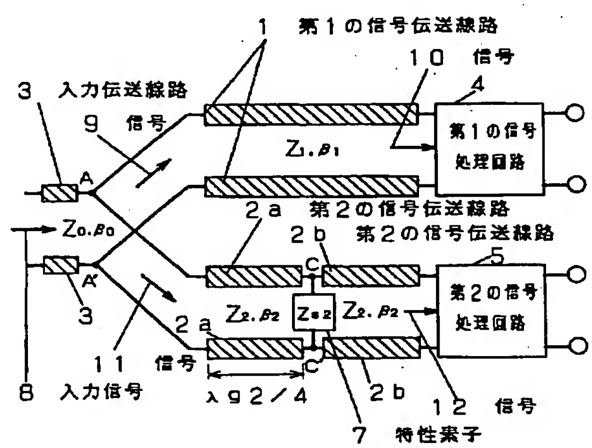
(72)発明者　東野　秀隆
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(72)発明者　瀬恒　謙太郎
大阪府門真市大字門真1006番地　松下電器産業株式会社内

(74)代理人　弁理士　滝本　智之　（外1名）

(54)【発明の名称】　超伝導信号処理装置

(57)【要約】
【課題】　移動体通信無線基地局等に使用される超伝導信号処理ユニットにおいて、高信頼性動作を確保することを目的とする。
【解決手段】　信号伝送線路1には超伝導材料から構成されるフィルタ等の信号処理回路4が接続され、信号伝送線路2bには常伝導材料から構成される信号処理回路5が接続され、信号伝送線路2bの他端には1／4管内波長の長さの信号伝送線路2aが接続され、これと信号伝送線路1の入力端が入力伝送線路3に並列接続する。



1

【特許請求の範囲】

【請求項１】　超伝導材料からなる第１の信号伝送線路と、常伝導材料からなる第２の信号伝送線路と、前記第１の信号伝送線路の出力端が超伝導材料から構成される第１の信号処理回路に接続され、前記第２の信号伝送線路の出力端が常伝導材料から構成される第２の信号処理回路に接続され、かつ、前記第１の信号伝送線路の入力端と前記第２の信号伝送線路の入力端とが共に信号入力伝送線路に接続され、前記第２の信号伝送線路の入力端から管内波長の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）の場所に於いて、前記第２の信号処理回路の温度に依存してインピーダンスの変化する特性素子を介して、前記第２の信号伝送線路の信号の往路と帰路の間を短絡接続した構成であることを特徴とする超伝導信号処理装置。

【請求項２】　特性素子が、温度により抵抗値が急変する材料からなる短絡素子、または、前記短絡素子と直列接続されたコンデンサとからなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成に於て、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記特性素子も常伝導転移して抵抗が上昇し、特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたことを特徴とする請求項１に記載の超伝導信号処理装置。

【請求項３】　温度により抵抗値が急変する材料が超伝導材料であることを特徴とする請求項２に記載の超伝導信号処理装置。

【請求項４】　特性素子が、ダイオードスイッチ、または、直列接続されたコンデンサとダイオードスイッチとからなり、信号カット用のインダクタおよび、第１の信号処理回路の温度に依存して抵抗が変化する可変抵抗素子とを直列に介して、前記ダイオードスイッチが順方向バイアス接続された構成に於て、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記可変抵抗素子の抵抗が上昇して前記ダイオードスイッチがオン状態からオフ状態に転移駆動され、特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたことを特徴とする請求項１に記載の超伝導信号処理装置。

【請求項５】　可変抵抗素子が超伝導材料からなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成であることを特徴とする請求項４に記載の超伝導信号処理装置。

【請求項６】　特性素子が、ダイオードスイッチ、または、直列接続されたコンデンサとダイオードスイッチとからなり、第１の信号処理回路の温度を測定する温度センサからの出力により信号カット用のインダクタを介して前記ダイオードスイッチが駆動される構成に於て、前記第１の信号処理回路の温度上昇を検知して前記ダイオードスイッチを順方向バイアス状態にすることにより、特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたことを特徴とする請求項１に記載の超伝導信号処理装置。

2

【請求項７】　第１の信号伝送線路と、常伝導材料からなる第２の信号伝送線路と、前記第１の信号伝送線路の出力端が超伝導材料から構成される第１の信号処理回路に接続され、前記第２の信号伝送線路の出力端が常伝導材料から構成される第２の信号処理回路に接続され、かつ、前記第１の信号伝送線路の入力端と前記第２の信号伝送線路の入力端とが共に信号入力伝送線路に接続され、前記第１の信号伝送線路および、前記第２の信号伝送線路の各々の入力端から各々の管内波長の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）の場所に於いて、前記第１の信号処理回路の温度に依存してインピーダンスの変化する第１の特性素子および第２の特性素子を介して、各々の伝送線路の信号の往路と帰路の間を、各々短絡接続した構成であることを特徴とする超伝導信号処理装置。

【請求項８】　第１の特性素子が、第１のダイオードスイッチ、または、直列接続された第１のコンデンサと第１のダイオードスイッチからなり、前記第１のダイオードスイッチと信号カット用の第１のインダクタとが直列に接続され、これと並列に、第１の信号処理回路の温度に依存して抵抗が変化する第１の可変抵抗素子が接続され、これらがバイアス抵抗を介して直流バイアスされた構成に於て、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記第１の可変抵抗素子の抵抗が上昇して前記第１のダイオードスイッチを順方向バイアス状態にすることにより、第１の特性素子のインピーダンスを、第１の信号伝送線路の特性インピーダンスよりも十分小さくするようにしたことを特徴とする請求項７に記載の超伝導信号処理装置。

【請求項９】　第１の可変抵抗素子が超伝導材料からなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成であることを特徴とする請求項８に記載の超伝導信号処理装置。

【請求項１０】　第１の特性素子が、第１のダイオードスイッチまたは直列接続された第１のコンデンサと第１のダイオードスイッチとからなり、信号処理回路１の温度を測定する温度センサからの出力により信号カット用の第１のインダクタを介して前記第１のダイオードスイッチが駆動される構成に於て、前記第１の信号処理回路の温度上昇を検知して前記第１のダイオードスイッチを順方向バイアス状態にすることにより、第１の特性素子のインピーダンスを、第１の信号伝送線路の特性インピーダンスよりも十分小さくするようにしたことを特徴とする請求項７に記載の超伝導信号処理装置。

【請求項１１】　第２の特性素子が、超伝導材料からなる短絡素子、または、超伝導材料からなる短絡素子と直

列接続された第２のコンデンサとからなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成に於て、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記第２の特性素子も常伝導転移して抵抗が上昇し、第２の特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたことを特徴とする請求項７～１０のいずれかに記載の超伝導信号処理装置。

【請求項１２】　第２の特性素子が、第２のダイオードスイッチ、または、直列接続された第２のコンデンサと第２のダイオードスイッチとからなり、信号カット用の第２のインダクタおよび、第１の信号処理回路の温度に依存して抵抗が変化する第２の可変抵抗素子とを直列に介して、前記第２のダイオードスイッチが順方向バイアス接続された構成に於て、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記第２の可変抵抗素子の抵抗が上昇して前記第２のダイオードスイッチがオン状態からオフ状態に転移駆動され、第２の特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたことを特徴とする請求項７～１０のいずれかに記載の超伝導信号処理装置。

【請求項１３】　第２の特性素子が、第２のダイオードスイッチ、または、直列接続された第２のコンデンサと第２のダイオードスイッチとからなり、第１の信号処理回路の温度を測定する温度センサからの出力により信号カット用の第２のインダクタを介して前記第２のダイオードスイッチが駆動される構成に於て、前記第１の信号処理回路の温度上昇を検知して前記第２のダイオードスイッチを順方向バイアス状態にすることにより、第２の特性素子のインピーダンスが、第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたことを特徴とする請求項７～１０のいずれかに記載の超伝導信号処理装置。

【請求項１４】　第１の信号処理回路、および、第２の信号処理回路がフィルタ要素を含むことを特徴とする請求項１から１３に記載の超伝導信号処理装置。

【請求項１５】　超伝導材料が、酸化物超伝導体からなることを特徴とする請求項１～１４のいずれかに記載の超伝導信号処理装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、超伝導材料を用いたフィルタ等の信号処理回路ユニットに於いて、信号処理回路ユニットの温度上昇に伴う超伝導材料の常伝導転移による信号処理機能停止を防止するためのバイパス処理回路を組み込んだ超伝導信号処理ユニットに関する。本発明は、特に、受信用信号処理回路に適する発明である。

【０００２】

【従来の技術】従来の超伝導信号処理ユニットでは、超伝導材料を用いたフィルタ等の信号処理回路と、常伝導材料で構成される信号処理回路の２系統の信号処理回路が設置されており、それらをバイパスリレースイッチにより入力線路に接続切り替えする構成となっていた。常時は、超伝導信号処理回路部の温度をモニタしながら、超伝導信号処理回路に入力線路を接続し、その温度上昇時には、バイパスリレースイッチを駆動して入力線路を常伝導材料のバイパス回路に切り替えて、入力信号処理を行っていた。例えば、Superconducting Core Technologies, Inc.社のREACH™のカタログには、超伝導受信フィルタとそれに接続される低雑音増幅器（ＬＮＡ）を形成した信号処理回路と、温度上昇時のバイパス為の同軸線路へのスルー切り替えのバイパスリレースイッチとによる超伝導信号処理ユニットが例示されている。

【０００３】

【発明が解決しようとする課題】この超伝導信号処理ユニットにおいては、信号処理回路の部材として超伝導材料を用いているために、それを冷却して超伝導転移状態で使用することが必要となるが、信号処理回路の超伝導材料の温度上昇に伴い、超伝導信号処理回路が動作しなくなった場合でも、継続して安定な入力信号の信号処理動作を、低損失、高感度で行うことが要求されている。

【０００４】本発明は、上記のような、超伝導動作時には、低損失、高感度の信号処理動作を行い、温度上昇に伴う超伝導信号処理回路の機能低下時にも、連続的に安定な信号処理動作の実現を目的とする。従来の技術では、超伝導信号処理回路と、そのバイパス回路との切り替え部のバイパスリレースイッチ等に於ける信号伝搬損失が１ｄＢ程度発生する為に、超低損失特性が特徴である超伝導信号処理回路４の特性を犠牲にしてしまう課題があった。具体的には、例えば、信号処理回路４が超伝導バンドパスフィルタの場合には、うまく設計すると０．５ｄＢ程度の挿入損失が実現できるので、挿入損失１ｄＢのバイパスリレースイッチを用いると、超伝導信号処理回路を含む全体の挿入損失が１．５ｄＢと大きく劣化して、その性能が活かされないこととなっていた。

【０００５】

【課題を解決するための手段】この課題を解決するために、請求項１に記載の発明は、超伝導材料からなる第１の信号伝送線路と、常伝導材料からなる第２の信号伝送線路と、前記第１の信号伝送線路の出力端が超伝導材料から構成される第１の信号処理回路に接続され、前記第２の信号伝送線路の出力端が常伝導材料から構成される第２の信号処理回路に接続され、かつ、前記第１の信号伝送線路の入力端と前記第２の信号伝送線路の入力端とが共に信号入力伝送線路に接続され、前記第２の信号伝送線路の入力端から管内波長の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）の場所に於いて、前記第２の信号処理回路の温度に依存してインピーダン

スの変化する特性素子を介して、前記第２の信号伝送線路の信号の往路と帰路の間を、そ短絡接続した構成としたものである。

【０００６】また、請求項２に記載の発明は、請求項１に記載の特性素子が、温度により抵抗値が急変する材料からなる短絡素子、または、との短絡素子と直列接続されたコンデンサとから構成し、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成に於て、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記特性素子も常伝導転移して抵抗が上昇し、特性素子のインピーダンスが、第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたものである。

【０００７】特に、温度により抵抗値が急変する材料として超伝導材料が好ましい。更に、請求項４に記載の発明は、請求項１に記載の特性素子が、ダイオードスイッチ、または、直列接続されたコンデンサとダイオードスイッチとからなり、信号カット用のインダクタおよび、第１の信号処理回路の温度に依存して抵抗が変化する可変抵抗素子とを直列に介して、前記ダイオードスイッチが順方向バイアス接続された構成とし、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記可変抵抗素子の抵抗が上昇して前記ダイオードスイッチがオン状態からオフ状態に転移駆動され、特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたものである。

【０００８】特に、前記発明に於いて、可変抵抗素子が超伝導材料からなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成とすることが好ましい。

【０００９】また、請求項６に記載の発明は、請求項１に記載の特性素子２が、ダイオードスイッチ、または、直列接続されたコンデンサとダイオードスイッチとからなり、第１の信号処理回路の温度を測定する温度センサからの出力により信号カット用のインダクタを介して前記ダイオードスイッチが駆動される構成とし、前記第１の信号処理回路の温度上昇を検知して前記ダイオードスイッチを順方向バイアス状態にすることにより、特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたものである。

【００１０】次に、請求項７に記載の発明は、第１の信号伝送線路と、常伝導材料からなる第２の信号伝送線路と、前記第１の信号伝送線路の出力端が超伝導材料から構成される第１の信号処理回路に接続され、前記第２の信号伝送線路の出力端が常伝導材料から構成される第２の信号処理回路に接続され、かつ、前記第１の信号伝送線路の入力端と前記第２の信号伝送線路の入力端とが共に信号入力伝送線路に接続され、前記第１の信号伝送線

路および、前記第２の信号伝送線路の各々の入力端から各々の管内波長の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）の場所に於いて、前記第１の信号処理回路の温度に依存してインピーダンスの変化する第１の特性素子および第２の特性素子を介して、各々の伝送線路の信号の往路と帰路の間を、各々短絡接続したものである。

【００１１】更に、請求項８に記載の発明は、請求項７に記載の第１の特性素子を、第１のダイオードスイッチ、または、直列接続された第１のコンデンサと第１のダイオードスイッチから構成し、前記第１のダイオードスイッチと信号カット用の第１のインダクタとが直列に接続し、これと並列に、第１の信号処理回路の温度に依存して抵抗が変化する第１の可変抵抗素子を接続し、これらがバイアス抵抗を介して直流バイアスされた構成とし、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記第１の可変抵抗素子の抵抗が上昇して前記第１のダイオードスイッチを順方向バイアス状態にすることにより、第１の特性素子のインピーダンスを、第１の信号伝送線路の特性インピーダンスよりも十分小さくするようにしたものである。

【００１２】前記発明に於いて、第１の可変抵抗素子が超伝導材料からなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成が好ましい。

【００１３】また、請求項１０に記載の発明は、請求項７に記載の第１の特性素子が、第１のダイオードスイッチまたは直列接続された第１のコンデンサと第１のダイオードスイッチとからなり、信号処理回路１の温度を測定する温度センサからの出力により信号カット用の第１のインダクタを介して前記第１のダイオードスイッチが駆動される構成とし、前記第１の信号処理回路の温度上昇を検知して前記第１のダイオードスイッチを順方向バイアス状態にすることにより、第１の特性素子のインピーダンスを、第１の信号伝送線路の特性インピーダンスよりも十分小さくするようにしたものである。

【００１４】更に、請求項１１に記載の発明は、請求項７から１０に記載の第２の特性素子が、超伝導材料からなる短絡素子、または、超伝導材料からなる短絡素子と直列接続された第２のコンデンサとからなり、第１の信号処理回路を冷却する同一の冷却部材により冷却される構成とし、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記第２の特性素子も常伝導転移して抵抗が上昇し、第２の特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたものである。

【００１５】特性素子２が、超伝導材料からなる線路、または、超伝導材料からなる線路と直列接続されたコンデンサ２とからなり、信号処理回路１を冷却する同一の冷却部材により冷却される構成とし、前記信号処理回路１の温度上昇に伴う超伝導材料の常伝導転移の際に、前

記特性素子２も常伝導転移して抵抗が上昇し、特性素子２のインピーダンスが信号伝送線路２の特性インピーダンスよりも十分大きな値となるようにしたものである。

【００１６】また、請求項１２に記載の発明は、請求項７から１０に記載の第２の特性素子が、第２のダイオードスイッチ、または、直列接続された第２のコンデンサと第２のダイオードスイッチとからなり、信号カット用の第２のインダクタおよび、第１の信号処理回路の温度に依存して抵抗が変化する第２の可変抵抗素子とを直列に介して、前記第２のダイオードスイッチが順方向バイアス接続された構成とし、前記第１の信号処理回路の温度上昇に伴う超伝導材料の常伝導転移の際に、前記第２の可変抵抗素子の抵抗が上昇して前記第２のダイオードスイッチがオン状態からオフ状態に転移駆動され、第２の特性素子のインピーダンスが第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたものである。

【００１７】また、請求項１３に記載の発明は、請求項７から１０に記載の第２の特性素子が、第２のダイオードスイッチ、または、直列接続された第２のコンデンサと第２のダイオードスイッチとからなり、第１の信号処理回路の温度を測定する温度センサからの出力により信号カット用の第２のインダクタを介して前記第２のダイオードスイッチが駆動される構成とし、前記第１の信号処理回路の温度上昇を検知して前記第２のダイオードスイッチを順方向バイアス状態にすることにより、第２の特性素子のインピーダンスが、第２の信号伝送線路の特性インピーダンスよりも十分大きな値となるようにしたものである。

【００１８】以上の、本発明の超伝導信号伝送ユニットの実施様態として、第１の信号処理回路、および、第２の信号処理回路がフィルタ要素を含むことが好ましい。

【００１９】また、本発明の超伝導信号伝送ユニットの実施において、好ましい実施様態として、超伝導材料に酸化物超伝導体が用いることである。

【００２０】

【発明の実施の形態】以下、本発明の実施の形態について、図を用いて説明する。

【００２１】（実施の形態１）図１は本発明の一実施の形態による超伝導信号処理ユニットの構成を示す概念図を示し、図１において第１の信号伝送線路１は、第２の信号伝送線路２ａと接続点Ａ－Ａ’の場所で入力伝導線路３に接続されている。本実施の形態および以後の実施の形態の説明に於いては、説明の便宜上、伝送線路の形態を平行線路として行っている。第２の信号伝送線路２ａの長さはその管内波長（λ_{g2}）の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）であり、他端Ｃ－Ｃ’の場所には、それと同じ特性を有する第２の信号伝送線路２ｂが接続されている。第１の信号伝送線路１のもう一方の端部には超伝導材料から構成される第１の信号処理回路４が接続され、第２の信号伝送線路２ｂのもう一方の端部には常伝導材料から構成される第２の信号処理回路５が接続される。信号処理回路４及び５は、例えば、所望の信号のみを通す帯域通過フィルタや、スペクトル拡散信号の相関をとるコリレータ等の機能を実現した回路ユニットであり、対象信号周波数に対してはそれらの入力インピーダンスは、信号伝送線路１および２ｂの特性インピーダンスにほぼ整合させる。第２の信号伝送線路２ａと２ｂの接続点Ｃ－Ｃ’の場所には、両線路の各々の往路と帰路とを特性素子７で短絡接続する。特性素子７は、第１の信号処理回路４の温度に依存してインピーダンスが変化するもので、超伝導材料、または、ダイオードスイッチ等で構成されている。第１の信号処理回路４の温度が上昇してその特性が劣化した時、或いは、その特性劣化によるシステムに及ぼす悪影響を未然に防がなければならないような時、例えば、それを構成する超伝導材料が超伝導から常伝導へと転移して特性劣化を起こすような温度まで上昇したような時に、第２の信号伝送線路２ａおよび２ｂの特性インピーダンスに比べて、特性素子７のインピーダンスが極めて小さな値から大きな値へと変化するように構成されたものを用いる。特性素子７の具体的な実施の形態は後述する。ここでは、その動作原理について以下に説明する。

【００２２】（正常動作時）図１において、信号処理回路４が超伝導状態を維持する温度にあり、正常に機能している場合に付いて説明する。入力伝送線路３、および、第１の信号伝送線路１、第２の信号伝送線路２ａ、２ｂの特性インピーダンスを、各々、Z_0、Z_1、Z_2とし、伝搬定数を、β_0、β_1、β_2とする。具体的には、各特性インピーダンスZ_0、Z_1、Z_2は総て等しくするのが好ましい。また、信号処理回路４及び５の入力インピーダンスは、今考慮している信号周波数に対して、各々、信号伝送線路１および２ｂの特性インピーダンスにほぼ整合していることが好ましい。また、特性素子７のインピーダンスをZ_{s2}とする。実際の場合には、信号伝送線路２ａ、２ｂの損失が無視できるくらい小さい値であるので、この場合のＡ－Ａ’の場所から見た第２の信号伝送線路２ａのインピーダンスZ_{in2}は、（数１）となる。

【００２３】

【数１】

$$Z_{in2} = (Z_2)^2 / Z_{ct}$$

【００２４】ここで、Z_{ct}は

【００２５】

【数２】

$$Z_{ct} = Z_2 \cdot Z_{s2} / (Z_2 + Z_{s2})$$

【００２６】となる。入力伝送線路３からＡ－Ａ’の地点を見た場合のインピーダンスZ_{Ain}は次式で与えられる。

【0027】
【数3】

$$Z_{Ain}=Z_1\cdot Z_{in2}/(Z_1+Z_{in2})$$

【0028】今、Z_{s2}がZ_2に比べて十分小さい場合には、Z_{c2}はほぼZ_{s2}に等しくなり、Z_{in2}はZ_2に比べて無視できるくらい大きな値となる。従って、Z_{Ain}はほぼZ_1に等しくなる。この動作状態に於いては、入力信号８は入力伝送線路３から信号伝送線路１の方だけに伝搬し（信号９）、信号伝送線路２ａの方には信号１１が伝搬しなくなる。従って、信号３がほぼ損失無く伝搬し、信号１０として、第１の信号処理回路４に入力されて信号処理される。システムではこの処理された出力信号を用いることができる。信号伝送線路１は超伝導信号処理回路４と同じように冷却して用いるのが構成上有利であるので、その伝搬損失が十分小さく、無視でき、信号１０の入力信号８に対する信号電力伝達率T_1は（数４）で与えられる。

【0029】
【数4】

$$T_1=(1-|\Gamma|^2)\cdot Z_0/(Z_0+Z_{s2})$$

【0030】ここで、Γは次式で与えられる。

【0031】
【数5】

$$\Gamma=-Z_{s2}/(2Z_0+Z_{s2})$$

【0032】また、その信号伝達損失L_1（ｄＢ：デシベル）は（数６）で表される。

【0033】
【数6】

$$L_1=-10\ \mathrm{Log}(T_1)\quad(単位はｄＢ)$$

【0034】具体的な値としては、$Z_0=Z_1=Z_2=50\Omega$とすると、Z_{s2}が約６．７Ω以下で信号伝達損失L_1が０．５ｄＢ以下の値、約１．２Ωで０．１ｄＢ以下の値が実現できる。

【0035】（バイパス動作時）次に、信号処理回路４の超伝導材料が常伝導転移する温度で、正常に機能しない場合の動作に付いて説明する。この状態では、信号処理回路４の超伝導材料が常伝導となるために、その入力インピーダンスが信号伝送線路１の特性インピーダンスからずれていることが多く、また、信号処理回路４の出力は正常なものではなくなるので、システムでは用いることができない。他方、信号処理回路５の方には、以下に述べる理由で正常な信号処理出力が得られるので、システムではこちらの方の信号を選択することにより、システムの安定性が向上する。この動作原理に付いて以下に説明する。

【0036】図１に於いて、信号処理回路４の入力インピーダンスZ_4が信号伝送線路１の特性インピーダンスZ_1に整合しない場合には、信号伝送線路１の長さL_{TL1}を調節して、そのＡ－Ａ’点からみたインピーダンスZ_{in1}を入力伝送線路３の特性インピーダンスZ_0よりも十分大きく設定することができる。具体的には、Z_4がZ_1よりも小さい場合には、線路長さL_{TL1}を管内波長の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）にすることにより、（数１）と同様にインピーダンス変換されて十分大きなインピーダンスにすることができる。また、逆に、Z_4がZ_1よりも大きい場合には、線路長さL_{TL1}を管内波長の（ｋ／２）倍の長さ（ここで、ｋは零または正整数）にすることにより、Z_{in1}をZ_4に等しくすることができる。このような構成に於いては、入力信号８のほとんど総てが信号伝送線路２ａの方に（以下に述べるように、特性素子７のインピーダンスがZ_2よりも十分大きい場合には）伝送される。また、L_{TL1}を調節することによりZ_{in1}を純抵抗Ｒとすることができるので、この時のＲの値に付いて信号１１の入力信号８に対する伝達損失は、例えば、Ｒの値がZ_1の約２倍以上の時に－０．１８ｄＢ程度以下、Ｒの値がZ_1の約２．８倍以上の時に－０．１ｄＢ程度以下となる。また、Z_4がZ_1に整合する場合には、接続点Ａ－Ａ’に於いて、若干の反射が存在するが信号伝送線路２ａに信号１１が伝搬する（$Z_1=Z_2=Z_0$の場合には１／３の反射が発生し、信号伝送線路２ａには入力信号８の１／３の電力が伝搬することとなる）。

【0037】もし、第１の信号伝送線路１の構成材料が、銅や金等の常伝導金属である場合には、その温度が７７ケルビン付近で数十度変化しても特性インピーダンスや、伝送損失にはほとんど影響はでないので、上記のようになるが、Ｙ系やＢｉ系、Ｔｌ系等の酸化物高温超伝導体等の酸化物高温超伝導体材料を用いる場合には、常伝導状態時の抵抗率が$10^{-3}\Omega cm$程度と金属に比べて随分と大きい値であるので、超伝導状態時と、常伝導転移した時とでは、大いに異なる現象が現れることとなる。伝送線路をストリップライン線路構造として、以下にそれを具体的に説明する。

【0038】基板に厚み０．５ｍｍの$LaAlO_3$単結晶（比誘電率２４）を用いた時、その特性インピーダンスを５０Ωとするためには、線路幅は約０．１７ｍｍとすれば良く、この時、１／４管内波長は１３ｍｍ程度となるが、１ｃｍ当たりのストリップライン線路の直流抵抗が約６００Ω程度にもなるので、信号の減衰量は、移動体通信で用いられるような１．５ＧＨｚの周波数では、約３８ｄＢ／ｃｍ程度の値となる。線路長L_{TL1}が５ｍｍ程度の長さでもほとんど信号が減衰するので、信号処理回路４の入力インピーダンスの如何に係わらず、Z_{in1}はZ_1にほぼ等しくなる。従って、この場合には、第１の信号伝送線路１の構成材料が超伝導状態時と常伝導状態時とで、接続点Ａ－Ａ’から見た第１の信号伝送線路の入力インピーダンスはほぼ同じ値となり、この場合にはZ_1、Z_2をZ_0に等しくとるのが普通であるので、上述のように、信号伝送線路２ａには入力信号８の１／３の電力が伝搬することとなる。

【0039】上記のように、その割合は設計に依存するが、入力信号8の幾分かが信号11となって、第2の信号伝送線路2a中を伝搬する。特性素子7のインピーダンスZ_{s2}による、接続点B－B'に於ける信号伝達損失（信号111の電力に対する信号112の電力の比）L_2は（数7）で表される。

【0040】

【数7】

$$L_2 = \left(1 - \left(\frac{Z_2}{2Z_{s2} + Z_2}\right)^2\right) \frac{Z_{s2}}{Z_{s2} + Z_2}$$

【0041】例えば、Z_{s2}/Z_2が10の場合で、信号伝達損失L_2は約0．4dBとなり、Z_{s2}/Z_2が43以上では信号伝達損失L_2は約0．1dB以下が実現される。このように、特性素子7のインピーダンスZ_{s2}を、信号伝送線路2aの特性インピーダンスZ_2よりも十分に大きな値とすることにより、接続点C－C'での反射がほとんど無く信号12として信号処理回路5に入力されることとなるので、この出力を用いることにより、システム全体では所望の信号処理が可能となる。一般に、信号処理回路5は金属などの常伝導材料から構成されるので、超伝導材料で構成される信号処理回路4よりも、損失や、感度等の特性面で劣るものの、本発明の構成により、このように、安定な信号処理システム動作が実現できる。

【0042】ここで述べた特性素子7に関する発明に付いて、以下に実施例を図面を用いて説明する。

【0043】（実施の形態2）図2は、本発明の一実施の形態による超伝導信号処理ユニットの構成要素である、特性素子(2)部分の第一の実施形態を示す概念図を示す。図2で、第2の信号伝送線路102aと102bとの接続点C－C'に於いて、信号処理回路4（図1に図示）の温度に伴いインピーダンスを変化させる手段としての特性素子107が、温度により抵抗値が急変する材料からなる短絡素子117と直列接続されたコンデンサ127とから構成した例を示す。温度により抵抗値が急変する材料としては、超伝導材料を用いるのが好ましいが、何もこれに限定するのではなく、信号処理回路4を構成する超伝導材料が、超伝導から常伝導に転移する温度以下の温度で、抵抗が急減する材料で有れば良い。例えば、異常な温度抵抗率変化を示す、$La_{1-x}Sr_xMnO_3$、$La_{1-x}Sr_{1+x}MnO_4$、$(Nd, Sm)_{1/2}Sr_{1/2}MnO_3$等のCMR（巨大磁気抵抗効果）材料等も用いることができる。

【0044】図2に於いて、コンデンサ127が無く、超伝導短絡素子117で直接接続点C－C'間を短絡接続しても良い。両者の差は、前者では、特性素子107により信号伝送線路102a、102bが交流的だけで短絡接続されるのに対して、後者では、交流的だけでなく、直流的にも短絡接続されることである。また、図2に於いて、図示はされていないが、超伝導短絡素子117は、第1の信号処理回路4（図1に図示）を冷却する冷却部材と同一の冷却部材に設置して冷却するように構成されていることが必要である。第1の信号処理回路4の温度上昇に伴って、それを構成する超伝導材料が常伝導に転移する際に、特性素子107を構成する超伝導短絡素子117も常伝導転移して抵抗が上昇することにより、インピーダンスが、超伝導状態時には極めて小さな値から、極端に大きな値へと変化するように設計することが可能である（前記実施の形態1の説明文中を参照のこと）。このことにより、特性素子107のインピーダンスZ_{s2}が第2の信号伝送線路2a（図1に図示）の特性インピーダンスZ_2よりも十分大きな値となるような構成が実現できる。従って、実施の形態1で説明したように、第1の信号処理回路4が温度上昇によって機能しなくなった場合にも、第2の信号処理回路5からの出力に切り替えて用いることにより、安定な信号処理システム動作が実現できる。

【0045】具体的には、超伝導短絡素子117の材料としては、信号処理回路4を構成する超伝導材料と同じか類似の、$LnBa_2Cu_3O_{7-x}$（Ln＝Yおよび希土類元素）等のY系や$Bi_2Sr_2Ca_{n-1}Cu_nO_{2n+4-y}$（n=1～5）のBi系や、$Tl_2Ba_2Ca_{n-1}Cu_nO_{2n+4}$（n=1～4）、$Tl_1Ba_2Ca_{n-1}Cu_nO_{2n+3}$（n=1～5）、$Tl_1Sr_2Ca_{n-1}Cu_nO_{2n+3}$（n=2,3）等のTl系酸化物高温超伝導体等の酸化物高温超伝導体を用いるのが都合がよい。特に、第1の信号処理回路4を構成する超伝導材料と同じ超伝導体を用いる場合には、両者の転移温度がほぼ等しくなるために、冷凍機などの故障による温度上昇により、第1の信号処理回路4が動作しなくなるとほぼ同時に、第2の信号処理回路5（図1参照）に信号処理機能を自動的に切り替えることが可能となり、そのための温度モニタが不要となる。

【0046】また、超伝導短絡素子117の長さが、その管内波長の約1／10程度であれば集中定数として扱うことが可能であり、それ以上であれば、分布定数線路として扱って所望のインピーダンスに設計すればよい。例えば、基板として厚み0．5mmの$LaAlO_3$単結晶（比誘電率24）を用い、信号伝導線路2aとしてストリップライン型の50Ω線路を考えると、1／10管内波長は5．2mm程度となるので、この長さ以下で設計すれば集中定数として扱うことが可能である。例えば、図8に示すように、ストリップライン型の往路の信号伝送線路702aと702bの接続点に、超伝導短絡素子717を、長さ5mm、幅23μm、厚み1μmとすると、転移温度付近での抵抗率が10^{-3}Ωcmの酸化物高温超伝導薄膜を形成すれば約2150Ωとなり、第2の信号伝送線路702a、702bの特性インピーダンスが50Ωとすれば、信号伝達損失（信号711の電力に対する信号712の電力の比）L_2は（数7）より

約０．１ｄＢとなる。また、超伝導状態では、５０Ωに比べて全く無視できる程小さなインピーダンスが実現できている。この超伝導短絡素子が端子７３７に接続され、端子７３７がビアホール７２７で、信号伝送線路７０２ａ、７０２ｂの帰路である接地電極７０４に接続されている。また、図８では直接信号伝送線路７０２ａ，７０２ｂと接地電極７０４との間に短絡接続した例を示したが、この間にコンデンサを直列に挿入して短絡接続してもよいのはいうまでもない。

【００４７】なお、短絡素子の材料を超伝導体を用いた場合について述べたが、なにもこれに限定されるわけではなく、同様な機能を有する材料を用いることができるのは言うまでもない。超伝導体の代わりに、第１の信号処理回路４の超伝導材料が超伝導から常伝導に転移する温度付近で、抵抗率が１桁以上大きくなるような材料を用いても良いことは言うまでもない。具体的には、例えば、異常な温度抵抗率変化を示す、$La_{1-x}Sr_xMnO_3$、$La_{1-x}Sr_{1+x}MnO_4$、$(Nd,Sm)_{1/2}Sr_{1/2}MnO_3$等のＣＭＲ（巨大磁気抵抗効果）材料等も用いることができる。

【００４８】（実施の形態３）図３は本発明の一実施の形態による超伝導信号処理ユニット構成要素の、特性素子部分の第二の実施形態を示す概念図である。この図を用いて本発明に於ける特性素子部分の第二の実施形態を説明する。図３で、第２の信号伝送線路２０２ａと２０２ｂとの接続点Ｃ－Ｃ’に於いて、信号処理回路４（図１に図示）の温度に伴いインピーダンスを変化させる手段としての特性素子２０７が、直列接続されたコンデンサ２２７とダイオードスイッチ２１７とから構成されている。コンデンサ２２７は直流をカットするためのものであり、回路構成上、別に設ける必要がない場合には無くても良い。ダイオードスイッチ２１７の両端には、信号カット用のインダクタ２３７および、第１の信号処理回路の温度に依存して抵抗が変化する可変抵抗素子２４７とが直列接続されて、電源２６７により、ダイオードスイッチ２１７が順方向にバイアスされるように構成されている。また、同図に於いて、コンデンサ２２７が無く、ダイオードスイッチ２１７が接続点Ｃ－Ｃ’に直接短絡接続しても良い。両者の差は、前記実施の形態２で述べた通りである。また、図３に於いて、図示はされていないが、可変抵抗素子２４７は、第１の信号処理回路４（図１に図示）を冷却する冷却部材と同一の冷却部材に設置して冷却するように構成されていることが好ましい。

【００４９】まず、特性素子２０７を集中定数回路として扱える寸法以内に構成した場合について説明する。第１の信号処理回路４の温度が超伝導動作状態を保ち、正常な機能、動作を行っている場合には、可変抵抗素子２４７の抵抗は極めて小さい値である。特に、可変抵抗素子２４７が超伝導材料で構成される場合には、この場合には超伝導状態にあり、その抵抗は零である。そのため、電源２６７の電圧が、可変抵抗素子２４７とインダクタ２３７を通り、ダイオードスイッチ２１７に順方向に印加されているが、この場合には、可変抵抗素子２４７とインダクタ２３７の直流抵抗が極めて小さいために、ダイオードスイッチ２１７へのバイアス電流が大きくなり導通状態となる。導通状態となったダイオードスイッチ２１７の信号２１１、２１２に対するインピーダンスは信号伝送線路２０２ａ，２０２ｂの特性インピーダンスZ_2よりも十分に小さな値となる。コンデンサ２２７の静電容量を、インピーダンスが十分に小さな値になるような大きさに選んでおけば、特性素子２０７のインピーダンスも十分に小さな、短絡状態が実現できる。

【００５０】第１の信号処理回路４の温度上昇に伴って、それを構成する超伝導材料が常伝導に転移すると、可変抵抗素子２４７が超伝導状態から常伝導状態へと転移することにより、その直流抵抗が大きくなり、ダイオードスイッチ２１７は、そのバイアス電流が極めて小さくなるので、高抵抗状態、或いは遮断状態に転移する。この状態では、信号２１１、２１２に対するインピーダンスZ_{12}は信号伝送線路２０２ａ，２０２ｂの特性インピーダンスZ_2よりも十分に大きな値となり、解放状態に近い状態が実現できる。従って、実施の形態１で説明したように、第１の信号処理回路４が温度上昇によって機能しなくなった場合にも、第２の信号処理回路５からの出力に切り替えて用いることにより、安定な信号処理システム動作が実現できる。

【００５１】次に、特性素子２０７を分布定数回路として扱うことが必要な寸法で構成される場合について説明する。ダイオードスイッチ２１７を信号伝送線路２０２ａ，２０２ｂに接続する線路の長さを適当に調節することにより、例えば、管内波長の（ｋ／２）倍の長さ（ここで、ｋは零または正整数）とすることにより、ダイオードスイッチ２１７のインピーダンスがそのまま特性素子２０７のインピーダンスとなるので、上記のような動作が実現できる。

【００５２】或いは、図６に示すように可変抵抗素子をインダクタ２３７とダイオードスイッチ２１７との直列回路に並列接続することにより、上記の場合とは逆に、可変抵抗素子が常伝導転移した場合にのみダイオードスイッチ２１７を低インピーダンス状態とする構成として、ダイオードスイッチ２１７を信号伝送線路２０２ａ，２０２ｂに接続する線路の長さを、管内波長の（１／４＋ｍ／２）波長（ｍは零または正整数）とすることにより、（数１）に示されるのと同様に、インピーダンス反転がおこるので、特性素子２のインピーダンスが、可変抵抗素子が常伝導転移する際に、短絡状態から高インピーダンス状態へと転移する状態が実現できる。

【００５３】具体的な特性素子２０７の構成として、ダイオードスイッチ２１７としては、第１の信号処理回路

４が動作する温度、例えばその構成材料である超伝導体に、Ｙ系やＢｉ系、Ｔｌ系等の酸化物高温超伝導体等の銅を含む酸化物高温超伝導体を用いる場合には、液体窒素温度（７７ケルビン）程度でも動作するような高周波用のダイオード、例えば、ＧａＡｓ系等のショットキーダイオード等を用いるのが好ましい。また、可変抵抗素子２４７の材料としては、Ｙ系やＢｉ系や、Ｔｌ系等の銅を含む酸化物高温超伝導体を用いるのが好ましい。特に、第１の信号処理回路４を構成する超伝導材料と同じ物を用いる場合には、それと同じ冷却部材に固定することにより、冷凍機などの故障による温度上昇により、第１の信号処理回路４が動作しなくなるとほぼ同時に、第２の信号処理回路５（図１参照）に信号処理機能を自動的に切り替えることが可能となり、温度モニタが不要となる。

【００５４】なお、上記説明では、可変抵抗素子２４７の材料を超伝導体を用いた場合について述べたが、なにもこれに限定されるわけではなく、同様な機能を有する材料を用いることができるのは言うまでもない。超伝導体の代わりに、第１の信号処理回路４の超伝導材料が超伝導から常伝導に転移する温度付近で、抵抗率が１桁以上大きくなるような材料を用いても良いことは言うまでもない。具体的には、具体的には、例えば、異常な温度抵抗率変化を示す、$La_{1-x}Sr_xMnO_3$、$La_{1-x}Sr_{1+x}MnO_4$、$(Nd, Sm)_{1/2}Sr_{1/2}MnO_3$等のＣＭＲ（巨大磁気抵抗効果）材料等も用いることができる。

【００５５】（実施の形態４）図４は、本発明の一実施の形態による超伝導信号処理ユニット構成要素の、特性素子部分の第三の実施形態を示す概念図を示す。図４に於いて、第２の信号伝送線路３０２ａと３０２ｂとの接続点Ｃ－Ｃ’に於いて、第１の信号処理回路４（図１に図示）の温度に伴いインピーダンスを変化させる手段としての特性素子３０７が、ダイオードスイッチ３１７から構成されている。別の実施態様では、ダイオードスイッチ３１７に、直列に直流をカットするためのコンデンサを設けることもある。ダイオードスイッチ３１７の両端には、信号カット用のインダクタ３３７を直列に介して、駆動回路３６７の出力線が接続されている。駆動回路３６７の入力信号として、第１の信号処理回路４の温度をモニタする温度センサ３５７が接続されている。第１の信号処理回路の温度モニタする温度センサ３５７の出力に依存して駆動回路３６７の出力が制御される。

【００５６】まず、特性素子３０７が、集中定数回路として取り扱えるぐらい小さな寸法で構成されている場合について説明する。ダイオードスイッチ３１７は、常時は低インピーダンス状態に駆動されて、第１の信号処理回路４を動作させる。第１の信号処理回路４の動作温度の上昇により、システムの機能低下を防止するために、信号処理回路を切り替える場合には、駆動回路３６７の駆動電流を小さくすることにより、ダイオードスイッチ３１７をオフ状態（高インピーダンス状態）にすることにより、特性素子３０７を、短絡（低インピーダンス）状態から高インピーダンスに転移させることができる。

【００５７】次に、特性素子３０７が、分布定数回路として取り扱わねばならない寸法の場合には、前述の（実施の形態３）で述べたものと同様にすれば、同様な機能が実現できる。

【００５８】以上のように、前記の実施形態と同様に、第１の信号処理回路４が温度上昇によって機能しなくなった場合にも、第２の信号処理回路５からの出力に切り替えて用いることにより、安定な信号処理システム動作が実現できる超伝導信号処理ユニットが実現できる。

【００５９】本実施例では、温度センサ３５７の出力により駆動回路３６７でダイオードスイッチ３１７のインピーダンス、即ち、特性素子３１７のインピーダンスを制御するので、正常動作とバイパス動作との切り替え温度を任意に設定でき、超伝導信号処理回路４が動作しなくなる前に、あらかじめ、バイパスの第２の信号処理回路５に切り替えることが可能である。このようにすることにより、超伝導信号処理ユニットの信頼性、安定性を向上させることが可能になる。

【００６０】（実施の形態５）図５は、本発明の他の実施の形態による超伝導信号処理ユニットを示す概念図を示す。図５において、第１の信号伝送線路４０１ａは、第２の信号伝送線路４０２ａと接続点Ａ－Ａ’の場所で入力伝導線路４０３に接続されている。本実施の形態および以後の実施の形態の説明に於いては、説明の便宜上、伝送線路の形態を平行線路として行っている。

【００６１】第１の信号伝送線路４０１ａの長さはその管内波長（λ_{g1}）の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）であり、他端Ｂ－Ｂ’の場所には、それと同じ特性を有する第１の信号伝送線路４０１ｂが接続されている。そのもう一方の端部には超伝導材料から構成される第１の信号処理回路４０４が接続されている。接続点Ｂ－Ｂ’の場所には、両線路の各々の往路と帰路とが特性素子４０６で短絡接続されている。特性素子４０６は、第１の信号処理回路４０４の温度に依存してインピーダンスが変化するものであり、ダイオードスイッチや超伝導材料等で構成されている。

【００６２】他方、第２の信号伝送線路４０２ａの長さは、その管内波長（λ_{g2}）の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）であり、その他端Ｃ－Ｃ’の場所には、それと同じ特性を有する第２の信号伝送線路４０２ｂが接続されている。第２の信号伝送線路４０２ｂのもう一方の端部には常伝導材料から構成される第２の信号処理回路４０５が接続されている。接続点Ｃ－Ｃ’の場所には、両線路の各々の往路と帰路とを特性素子４０７で短絡接続されている。特性素子４０７は、第１の信号処理回路４０４の温度に依存してインピ

ーダンスが変化するものであり、ダイオードスイッチ、超伝導材料等で構成されている。

【００６３】信号処理回路４０４及び４０５は、例えば、所望の信号のみを通す帯域通過フィルタや、スペクトル拡散信号の相関をとるコリレータ等の機能を実現した回路ユニットであり、対象信号周波数に対しては、それらの入力インピーダンスは、信号伝送線路４０１ｂおよび４０２ｂのそれぞれの特性インピーダンスにほぼ整合されているのが好ましい。

【００６４】第１の信号処理回路４０４の温度が上昇してその特性が劣化した時、或いは、その特性劣化によるシステムに及ぼす悪影響を未然に防がなければならないような時、例えば、それを構成する超伝導材料が超伝導から常伝導へと転移して特性劣化を起こすような温度まで上昇したような時には、第１の信号伝送線路４０１ａ、４０１ｂの特性インピーダンスに比べて、特性素子４０６のインピーダンスが極めて小さな値から大きな値へと変化するように構成され、第２の信号伝送線路４０２ａ、４０２ｂの特性インピーダンスに比べて、特性素子４０７のインピーダンスが極めて小さな値から大きな値へと変化するように構成されたものを用いる。特性素子４０６、４０７の具体的な実施の形態は後述する。

【００６５】請求項７に記載の本発明の実施に於いては、第１の信号処理回路４０４が超伝導状態にある正常動作温度では、接続点Ａ－Ａ’から見た第１の信号伝送線路４０１ａの入力インピーダンスZ_{in1}はZ_1（＝Z_0）であり、第２の信号伝送線路４０２ａの入力インピーダンスZ_{in2}は高インピーダンスとなっている。第１の信号処理回路４０４が常伝導状態に転移したバイパス動作時の温度では、逆に、Z_{in1}は高インピーダンスとなり、Z_{in2}がZ_2（＝Z_0）に等しくなるように構成されている。その詳細な動作原理について以下に説明する。

【００６６】（正常動作時）図５において、信号処理回路４０４が超伝導状態を維持する温度にあり、正常に機能している場合に付いて説明する。入力伝送線路４０３、および、第１の信号伝送線路４０１ａと４０１ｂ、および、第２の信号伝送線路４０２ａと４０２ｂの特性インピーダンスを、各々、Z_0、Z_1、Z_2とし、伝搬定数を、β_0、β_1、β_2とする。具体的には、各特性インピーダンスZ_0、Z_1、Z_2は総て等しくするのが好ましい。また、信号処理回路４０４及び４０５の入力インピーダンスは、今考慮している信号周波数に対して、各々、信号伝送線路４０１ｂおよび４０２ｂの特性インピーダンスにほぼ整合していることが好ましい。また、特性素子４０６、４０７のインピーダンスを、各々、Z_{s1}、Z_{s2}とする。

【００６７】この動作状態の場合には、Z_{s1}がZ_1よりも十分に大きく、Z_{s2}がZ_2よりも無視できるくらい小さい値であるので、（実施の形態１）で述べたように、第２の信号伝送線路４０２ａの入力インピーダンスZ_{in2}は高インピーダンス状態となり、入力信号４０８はほとんど損失無く、信号４０９として第１の信号伝送線路４０１ａに入力される。信号４０９は、接続点Ｂ－Ｂ’での特性素子４０６の短絡接続による、極わずかの信号の反射損失を受け、信号処理回路４０４への入力信号４１０として伝搬する。この際に接続点Ｂ－Ｂ’で受ける損失は、（数６）で、Z_2をZ_1に、Z_{s2}をZ_{s1}に置き換えて評価することができる。第２の信号伝送線路４０２ａの動作に付いては、（実施の形態１）と同様である。

【００６８】以上のように、正常動作時には、第１の信号処理回路４０４から処理出力が得られ、かた、途中での信号伝達損失も極めて小さくすることが可能となる。

【００６９】（バイパス動作時）次に、信号処理回路４０４の超伝導材料が常伝導転移する温度で、正常に機能しない場合の動作、即ち、バイパス動作に付いて説明する。この状態では、信号処理回路４０４の超伝導材料が常伝導となるために、その出力は、システムでは用いることができない。他方、信号処理回路４０５の方には、（実施の形態１）と同様の理由で、正常な信号処理出力が得られるので、システムではこちらの方の信号を選択することにより、システムの安定性が向上する。

【００７０】この状態に於いては、接続点Ｂ－Ｂ’での第１の特性素子４０６のインピーダンスZ_{s1}は、Z_1に比べて極めて小さな値となっているので、接続点Ａ－Ａ’から見た信号伝送線路４０１ａの入力インピーダンスZ_{in1}は（数１）、（数２）において、Z_{in2}をZ_{in1}に、Z_2をZ_1に、Z_{s2}をZ_{s1}と、置き換えることにより求められ、Z_{s1}は極めて大きな値が実現できる。入力伝送線路４０３からＡ－Ａ’の地点を見た場合のインピーダンスZ_{A1n}は（数３）で、Z_1をZ_2に、Z_{in2}をZ_{in1}に置き換えることにより求められ、Z_{A1n}はほぼZ_2に等しくなる。従って、入力信号４０８は、入力伝送線路４０３から信号伝送線路４０２ａの方だけに伝搬し（信号４１１）、信号伝送線路４０１ａの方には、信号４０９が伝搬しなくなる。

【００７１】また、接続点Ｃ－Ｃ’での特性素子４０７のインピーダンスは、この状態では、特性インピーダンスZ_2に比べて極めて高い値となるように構成されるので、信号信号４１１は、特性素子４０７の短絡接続による、極めて僅かの信号伝達損失しか受けずに伝搬し、信号４１２として第２の信号処理回路４０５に入力されて信号処理される。システムではこの処理された出力信号を用いることができ、安定な信号処理システム動作が実現できる。

【００７２】信号伝送線路４０１ａ、４０１ｂ、４０２ａ、４０２ｂは超伝導信号処理回路４０４と同じように冷却して用いるのが構成上有利であり、その線路自体の伝搬損失が十分小さく、無視できるので好ましい。本発

明の構成に於ける信号伝送線路４０１ａの構成電極材料として、温度変化によりその抵抗が余り大きく変わらないような常伝導金属、例えば、銅や金など、を用いるのが好ましい。これは、その温度が７７ケルビン付近で数十度変化しても特性インピーダンスや、伝送損失にはほとんど影響はでないので、上記のような動作が容易に実現できるからである。

【００７３】以上のように、本実施形態では、バイパス動作時に於いて、入力信号４０８が第２の信号処理回路４０５に信号４１２として伝搬される際の信号伝達損失が、（実施の形態１）の場合よりも、容易に小さくできる構成となっている。本発明に関する更に詳しい説明を以下に述べる。

【００７４】（実施の形態６）図６は、本発明の超伝導信号処理ユニットの他の実施形態例を示す図５に於ける構成要素のうち、第１の特性素子部分の第一の実施形態を示す概念図を示す。図６において、管内波長（λ_{g1}）の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）の第１の信号伝送線路５０１ａと、信号伝送線路５０１ｂとの接続点Ｂ－Ｂ’に於いて、信号処理回路４０４（図５に図示）の温度に伴いインピーダンスを変化させる手段としての、第１の特性素子５０６が、直列接続されたコンデンサ５２７と第１のダイオードスイッチ５１７とから構成されている。コンデンサ５２７は直流をカットするためのものであり、回路構成上、別に設ける必要がない場合には無くても良い。第１のダイオードスイッチ５１７の方端には、信号カット用の第１のインダクタ５３７が直列接続され、ダイオードスイッチ５１７とインダクタ５３７の直列回路の両端部には、第１の信号処理回路４０４の温度に依存して抵抗が変化する第１の可変抵抗素子５４７と、電源５６７とバイアス抵抗５５７の直列接続回路とが、並列に接続されており、可変抵抗素子５４７の抵抗値が十分大きい場合には、ダイオードスイッチ５１７が順方向バイアスされるように構成されている。

【００７５】他方、図５に於ける第２の特性素子４０７の構成としては、例えば、図２に示すような超伝導短絡素子１１７を用いるもの、或いは、図３に示すような第２のダイオードスイッチと第２のインダクタ２３７および第２の可変抵抗素子２４７の直列回路を用いるもの、更には、図４に示すような第２のダイオードスイッチ３１７と直列接続の第２のインダクタ３３７を、第１の信号処理回路４０４（図５）の動作温度をモニタする温度センサ３５７からの入力で駆動回路３６７により駆動する構成としたものなどが、用いられる。それらの機能動作に関しては、前述の（実施の形態３～５）において述べた通りである。

【００７６】また、図６に於いて、第１の可変抵抗素子５４７と、超伝導短絡素子１１７、または、第２の可変抵抗素子２４７等は、図示されてはいないが、第１の信号処理回路４０４（図５）を冷却する冷却部材と同一の冷却部材に設置して冷却するように構成されていることが好ましい。

【００７７】このような構成とすることにより、超伝導材料からなる第１の信号処理回路が超伝導状態にある場合には、第１の特性素子５０６のインピーダンスが解放状態に近い大きな値となり、第２の特性素子４０７（図５）のインピーダンスが短絡状態の極めて小さな値にすることができる。従って、（実施の形態５）に於いて説明したような機能作用を発現して、超伝導材料からなる第１の信号処理回路４０４が温度上昇によって機能しなくなった場合にも、第２の信号処理回路４０５からの出力に切り替えて用いることにより、安定な信号処理システム動作が実現できる。

【００７８】以下には、第１の特性素子５０６の具体的な実施形態について説明する。まず、第１の特性素子５０６を集中定数回路として扱える寸法以内に構成した場合について説明する。第１の信号処理回路４０４（図５）の温度が超伝導動作状態を保ち、正常な機能、動作を行っている場合には、第１の可変抵抗素子５４７の抵抗は極めて小さい値である。特に、可変抵抗素子５４７が超伝導材料で構成される場合には、この状態では超伝導状態にあり、その抵抗は零である。そのため、電源５６７の電圧が、可変抵抗素子５４７で短絡されるために、第１のダイオードスイッチ５１７にはバイアス電圧は印加されないので、オフ状態（高インピーダンス状態）となっている。コンデンサ５２７の静電容量値が十分大きく、そのインピーダンスが十分に小さくなるように設定するので、特性素子５０６のインピーダンスZ_{s1}は第１のダイオードスイッチ５１７のインピーダンスにほぼ等しくなるので、極めて大きな値となる。従って、信号５０９は、接続点Ｂ－Ｂ’に於いて、ほとんど損失を受けること無く伝搬して信号５１０となって第１の超伝導信号処理回路４０４へと供給される。

【００７９】第１の信号処理回路４０４の温度上昇に伴って、それを構成する超伝導材料が常伝導に転移すると、第１の可変抵抗素子５４７が超伝導状態から常伝導状態へと転移することにより、その直流抵抗が大きくなり、第１のダイオードスイッチ５１７には、直列接続された第１のインダクタ５３７と、バイアス抵抗５５７を通して電源５６７により順方向バイアスされて電流が流れ、そのインピーダンスは極めて小さな値になり、特性素子５０６のインピーダンスZ_{s1}は極めて小さくなる。接続点Ａ－Ａ’での第１の信号伝送線路５０１ａの入力インピーダンスは、その長さが（１／４＋ｍ／２）λ_{g1}（ここで、ｍは零または正整数）であるので、前述の原理と同様に、小さな値のZ_{s1}がインピーダンス変換されて、非常に大きいインピーダンスZ_{in1}となる。

【００８０】次に、特性素子５０６を分布定数回路として扱うことが必要な寸法で構成される場合について説明

する。第１のダイオードスイッチ５１７を信号伝送線路５０１ａ，５０１ｂに接続する線路の長さを、例えば、管内波長の管内波長の（ｋ／２）倍の長さ（ここで、ｋは零または正整数）とすることにより、第１のダイオードスイッチ５１７のインピーダンスがそのまま特性素子５０６のインピーダンスZ_{s1}となるので、上記のような動作が実現できる。

【００８１】或いは、図３に示すように第１の可変抵抗素子を第１のインダクタと第１のダイオードスイッチとの直列回路に並列接続することにより、上記の場合とは逆に、第１の可変抵抗素子が常伝導転移した場合にのみ第１のダイオードスイッチを低インピーダンス状態とする構成として、第１のダイオードスイッチを信号伝送線路５０１ａ，５０１ｂに接続する線路の長さを、管内波長の（１／４＋ｍ／２）波長（ｍは零または正整数）とすることにより、（数１）式に示されるのと同様に、インピーダンス反転させて、特性素子５０６のインピーダンスZ_{s1}が、可変抵抗素子が常伝導転移する際に、短絡状態から高インピーダンス状態へと転移する状態が実現できる。

【００８２】以上のように、集中定数回路、或いは、分布定数回路として、特性素子５０６が構成できる。

【００８３】以上のような、具体的な第１の特性素子５０６の構成としては、第１のダイオードスイッチ５１７としては、超伝導材料から構成される第１の信号処理回路４０４が動作する温度、例えばその構成材料である超伝導体に、Ｙ系やＢｉ系、Ｔｌ系等の酸化物高温超伝導体等の銅を含む酸化物高温超伝導体を用いる場合には、液体窒素温度（７７ケルビン）程度でも動作するような高周波用のダイオード、例えば、ＧａＡｓ系等のショットキーダイオード等を用いるのが好ましい。また、第１の可変抵抗素子５４７の材料としては、Ｙ系やＢｉ系や、Ｔｌ系等の銅を含む酸化物高温超伝導体を用いるのが好ましい。特に、第１の信号処理回路４０４を構成する超伝導材料と同じ物を用いる場合には、それと同じ冷却部材に固定することにより、冷凍機などの故障による温度上昇により、第１の信号処理回路４０４が動作しなくなるとほぼ同時に、第２の信号処理回路４０５に信号処理機能を自動的に切り替えることが可能となり、温度モニタが不要となる。

【００８４】なお、上記説明では、第１の可変抵抗素子５４７の材料を超伝導体を用いた場合について述べたが、なにもこれに限定されるわけではなく、同様な機能を有する材料を用いることができるのは言うまでもない。超伝導体の代わりに、第１の信号処理回路４の超伝導材料が超伝導から常伝導に転移する温度付近で、抵抗率が１桁以上大きくなるような材料を用いても良いことは言うまでもない。具体的には、具体的には、例えば、異常な温度抵抗率変化を示す、$La_{1-x}Sr_xMnO_3$、$La_{1-x}Sr_{1+x}MnO_4$、$(Nd,Sm)_{1/2}Sr_{1/2}MnO_3$等のＣＭＲ（巨大磁気抵抗効果）材料等も用いることができる。

【００８５】また、特性素子４０７（図５）の具体的な実施形態については、（実施の形態３～５）において述べた通りである。

【００８６】（実施の形態７）図７は、本発明の超伝導信号処理ユニットの他の実施形態例を示す図５に於ける構成要素のうち、第１の特性素子部分の第二の実施形態を示す概念図を示す。図７に於いて、管内波長（λ_{g1}）の（１／４＋ｍ／２）倍の長さ（ここで、ｍは零または正整数）の第１の信号伝送線路６０１ａと第１の信号伝送線路６０１ｂとの接続点Ｃ－Ｃ’に於いて、第１の信号処理回路４０４（図５）の温度に伴ってインピーダンスを変化させる手段としての特性素子６０６が、第１のダイオードスイッチ６１６およびそのバイアス回路と、それに直列に接続された直流カット用のコンデンサ６２６から構成されている。別の実施態様では、コンデンサ６２６を含まない回路構成であることもある。第１のダイオードスイッチ５１６の両端には、信号カット用の第１のインダクタ６３６を直列に介して、第１の駆動回路６６６の出力線が接続されている。第１の駆動回路６６６の入力信号として、第１の信号処理回路４０４の温度をモニタする第１の温度センサ６５６が接続されている。第１の温度センサ６５６の出力に依存して第１の駆動回路６６６の出力が制御される。

【００８７】第１の特性素子の機能動作に関して、以下に説明する。まず、第１の特性素子６０６が、集中定数回路として取り扱えるぐらい小さな寸法で構成されている場合について説明する。第１のダイオードスイッチ６１６は、常時はオフ状態（高インピーダンス状態）にされている。この時の特性素子６０６のインピーダンスZ_{s1}は非常に大きな値であり、接続点Ｂ－Ｂ’での信号伝達損失が極めて小さな値となるように構成することが可能である。

【００８８】第１の信号処理回路４０４の動作温度の上昇によるシステムの機能低下を防止するために信号処理回路を切り替える場合には、第１の駆動回路６６６の駆動電流を大きくすることにより、第１のダイオードスイッチ６１６を、導通状態（または、オン状態：低インピーダンス状態）に駆動する。この時の特性素子６０６のインピーダンスZ_{s1}は極めて小さくなり、信号６０９は接続点Ｂ－Ｂ’でほぼ完全に反射される。従って、前述のように、接続点Ａ－Ａ’から見た第１の信号伝送線路６０１ａの入力インピーダンスは、Z_1に比べて非常に大きくなる。この時に、入力信号４０８（図５）は、第２の信号伝送線路４０２ａ（図５）へと伝搬する（信号４１１）。

【００８９】次に、第１の特性素子６０６が、分布定数回路として取り扱わねばならない寸法の場合には、前述と類似の構成で、同様な機能が実現できる。

【００９０】また、特性素子４０７（図５）の具体的な実施形態については、（実施の形態３～５）において述べたものを用いることが可能である。

【００９１】以上のように、前記の実施形態と同様に、第１の信号処理回路４０４が温度上昇によって機能しなくなった場合にも、第２の信号処理回路５からの出力に切り替えて用いることにより、安定な信号処理システム動作が実現できる超伝導信号処理ユニットが実現できる。

【００９２】本実施例では、第１の温度センサ６５６の出力により第１の駆動回路６６６で、第１のダイオードスイッチ６１６のインピーダンス、即ち、第１の特性素子６０６のインピーダンスZ_{s1}を制御するので、正常動作とバイパス動作との切り替え温度を任意に設定でき、超伝導信号処理回路４０４が動作しなくなる前に、あらかじめ、バイパス回路の第２の信号処理回路４０５に切り替えることが可能である。このようにすることにより、超伝導信号処理ユニットの信頼性、安定性を向上させることが可能になる。

【００９３】（実施の形態８）図８は、本発明の実施の形態による超伝導信号処理ユニット構成要素の、特性素子部分の他の実施形態を示す構成模式図を示す。以上の実施の形態の説明に於いては、説明の便宜上、伝送線路の形態を平行線路として行っていたが、この線路構造に限定するものではない。図８に示すような、ストリップライン型線路を用いることも良い。この場合には、第１、または、第２の特性素子を構成する方法に工夫が必要であるので、ここでは、第２の特性素子に於いて、図２に対応する、超伝導短絡素子を用いる場合について、図８を用いて説明するが、他の構成を用いる場合や、第１の特性素子に関しても同様に適用が可能であることは言うまでもない。

【００９４】図８に於いて、第２の信号伝送線路の信号の往路７０２ａ、７０２ｂの接続点に、超伝導短絡素子７１７が接続されている。この接続点が、図２に於けるＣ点に対応する。第２の信号伝送線路の信号の帰路は接地電極７０４である。超伝導短絡素子７１７の他端は、端子７３７に接続されている。端子７３７は基板に設けられたビアホール７２７により、接地電極７０４と電気的に接続されている。ビアホール７２７の接地電極７０４との接続点が、図２に於ける接続点Ｃ' に対応する。このように、平面回路構成を用いても、以上述べたような超伝導信号処理回路ユニットを構成することが可能である。

【００９５】なお、以上の説明では、第１の信号処理回路４、４０４を構成する超伝導材料、或いは、超伝導短絡素子や、可変抵抗素子等を構成する超伝導材料を、$LnBa_2Cu_3O_{7-x}$（Ｌｎ＝Ｙおよび希土類元素）等のＹ系や$Bi_2Sr_2Ca_{n-1}Cu_nO_{2n+4-y}$ (n=1～5) のＢｉ系や、$Tl_2Ba_2Ca_{n-1}Cu_nO_{2n+4}$ (n=1～4)、$Tl_1Ba_2Ca_{n-1}Cu_nO_{2n+3}$ (n=1～5)、$Tl_1Sr_2Ca_{n-1}Cu_nO_{2n+3}$ (n=2,3) 等のＴｌ系酸化物高温超伝導体等の酸化物高温超伝導体を用いて構成した例で説明したが、その他のＨｇ系酸化物高温超伝導体についても同様に実施可能である。

【００９６】また、基板$LaAlO_3$単結晶を用いて構成した例で説明したが、その他のＭｇＯや$SrTiO_3$、$GaAlO_3$等についても同様に実施可能である。

【００９７】更に、短絡素子や、可変抵抗素子の材料を超伝導体を用いて構成した例で説明したが、その他の材料、第１の信号処理回路の超伝導材料が超伝導から常伝導に転移する温度以下で抵抗率が１桁以上小さくなるような材料、例えば、$La_{1-x}Sr_xMnO_3$、$La_{1-x}Sr_{1+x}MnO_4$、$(Nd, Sm)_{1/2}Sr_{1/2}MnO_3$等のＣＭＲ（巨大磁気抵抗効果）材料等についても同様に実施可能である。

【００９８】

【発明の効果】以上のように本発明によれば、超伝導信号処理ユニットの動作温度が上昇して、超伝導状態が壊れた場合にも、常伝導材料で構成されるバイパス用の信号処理回路に、低損失にかつ、自動的に切り替えて、信号処理を行うこととが可能となるので、高感度で、かつ、高信頼性、高安定性の信号処理が可能となる、という極めて顕著な効果が得られる。

【図面の簡単な説明】

【図１】本発明の一実施の形態による超伝導信号処理ユニットを示す概念図

【図２】本発明の一実施の形態による超伝導信号処理ユニット構成要素の、特性素子部分の第一の実施形態を示す概念図

【図３】本発明の一実施の形態による超伝導信号処理ユニット構成要素の、特性素子部分の第二の実施形態を示す概念図

【図４】本発明の一実施の形態による超伝導信号処理ユニット構成要素の、特性素子部分の第三の実施形態を示す概念図

【図５】本発明の他の実施の形態による超伝導信号処理ユニットを示す概念図

【図６】本発明の超伝導信号処理ユニットの他の実施形態例（図５）に於ける構成要素の第１の特性素子部分の第一の実施形態を示す概念図

【図７】本発明の超伝導信号処理ユニットの他の実施形態例（図５）に於ける構成要素の第１の特性素子部分の第二の実施形態を示す概念図

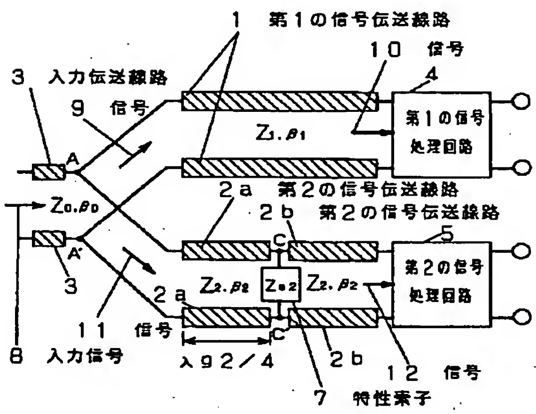
【図８】本発明の実施の形態による超伝導信号処理ユニット構成要素の第２の特性素子部分の他の実施形態を示す構成模式図

【符号の説明】

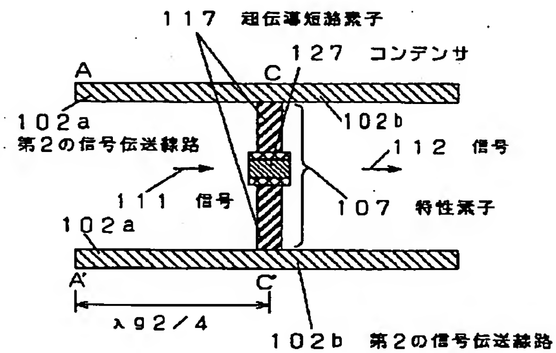
１，４０１ａ，４０１ｂ，５０１ａ，５０１ｂ，６０１ａ，６０１ｂ　第１の信号伝送線路

２ａ，２ｂ，１０２ａ，１０２ｂ，２０２ａ，２０２ｂ，３０２ａ，３０２ｂ，４０２ａ，４０２ｂ，７０２ａ，７０２ｂ　第２の信号伝送線路
３　入力伝送線路
４，４０４　第１の信号処理回路
５，４０５　第２の信号処理回路
７，１０７，２０７，３０７，４０６，４０７，５０６，６０６，７０７　特性素子
８，４０８　入力信号
９，１０，１１，１２，１１１，１１２，２１１，２１２，３１１，３１２，４０９，４１０，４１１，４１２，５０９，５１０，６０９，６１０，７１１，７１２　信号
１１７，７１７　短絡素子
１２７，２２７，５２７，６２６　コンデンサ
２１７，３１７，５１７，６１６　ダイオードスイッチ
２３７，３３７，５３７，６３６　インダクタ
２４７，５４７　可変抵抗素子
３５７，６５６　温度センサ
３６７，６６６　駆動回路
７０４　接地電極
７２７　ビアホール
７３７　端子

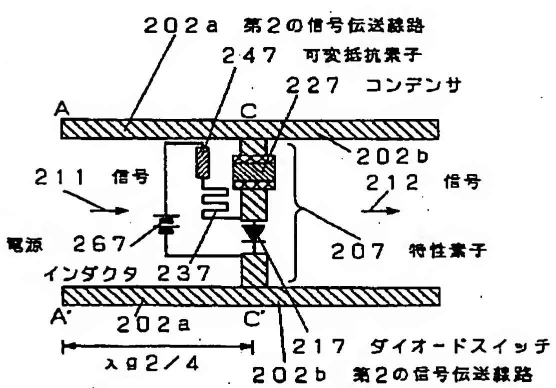
【図１】



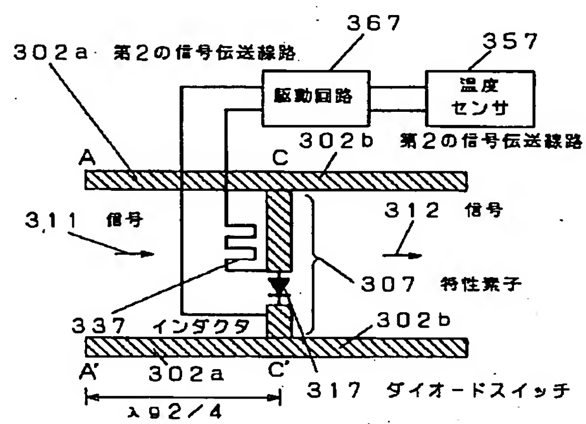
【図２】



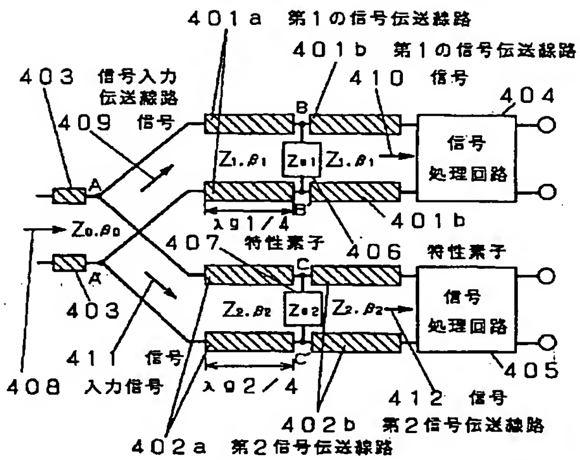
【図３】



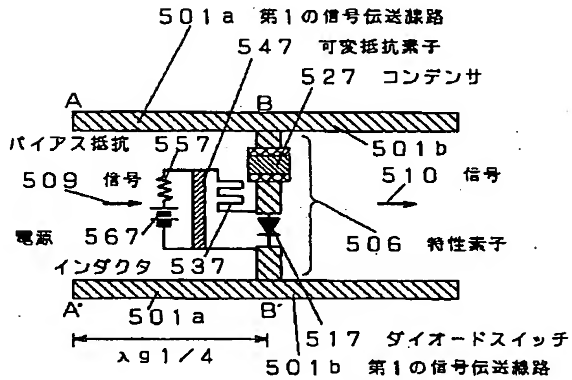
【図４】



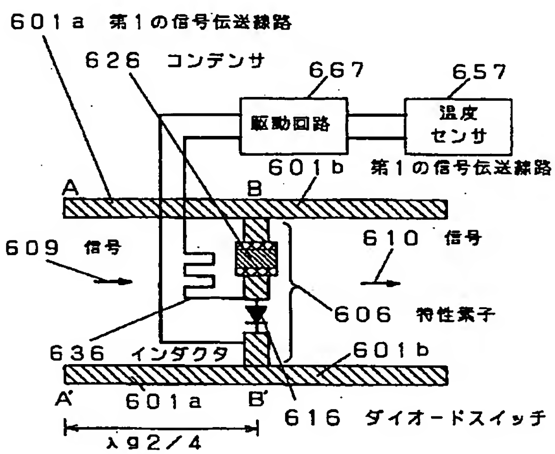
【図5】


401a 第1の信号伝送線路
401b 第1の信号伝送線路
403 信号入力伝送線路
410 信号
404
409 信号
信号処理回路
λg1/4
401b
407 特性素子
406 特性素子
403
信号処理回路
411 信号
408 入力信号
λg2/4
405
412 信号
402b 第2信号伝送線路
402a 第2信号伝送線路

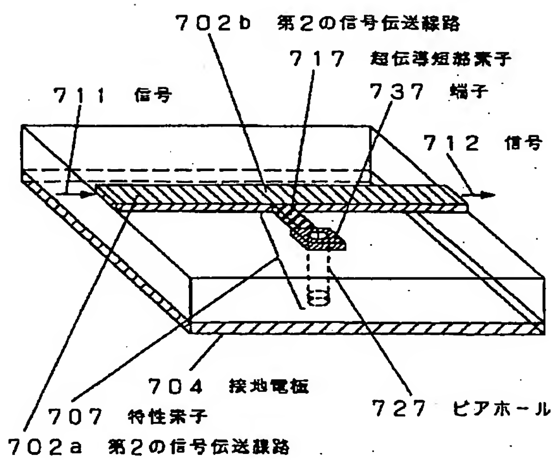
【図6】


501a 第1の信号伝送線路
547 可変抵抗素子
527 コンデンサ
バイアス抵抗 557
501b
509 信号
510 信号
電源 567
506 特性素子
インダクタ 537
501a
517 ダイオードスイッチ
λg1/4
501b 第1の信号伝送線路

【図7】


601a 第1の信号伝送線路
626 コンデンサ
667
657
駆動回路
温度センサ
601b 第1の信号伝送線路
609 信号
610 信号
606 特性素子
636 インダクタ
601b
601a
616 ダイオードスイッチ
λg2/4

【図8】


702b 第2の信号伝送線路
717 超伝導短絡素子
711 信号
737 端子
712 信号
704 接地電極
707 特性素子
727 ビアホール
702a 第2の信号伝送線路